

Engineering Drawing System Manual

Drawing Format, Requirements and Procedures

Verify this is the correct version before use



National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
Houston, Texas 77058

Engineering Drawing System Manual

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REVISIONS		
VER	CHANGE	DATE
--	Original version	6/64
A	Scope change to include flight hardware	2/87
B	Updated guidelines for compliance with Mil-Std-100	2/91
C	Major revision introducing Fabrication Approval, redline procedures, and electronic drawing control	8/97
D	New Section 1.4 describes implementation policy Modify 2.2.7 to reference PRC process specifications Modify 2.2.7b2 to specify instructions for MIP notes Add instructions to 2.3 for changing DCN numbers Modify 3.2.6c to require vendor next assy number Strike 3.2.7 e, f, i, & k regarding the EDCC database Strike last sentence in 3.3.1 regarding bookform dwgs Strike last paragraph in 3.3.4 on drawing cancellation Modify 3.6.2 to reflect electronic procedures	5/98
E	2.1.5 Reworded geometric dimensioning requirement and added specification on the use of English units 2.2.7a3 Relaxed restrictions on the depictions of flag notes 2.2.7b5 Added instructions for property tag note 2.3.2i Drawing trees now treated as diagram drawings 2.3.2.7.1 Added instructions to document temporary configurations 3.1.1 Revised procedure for obtaining drawing numbers 3.2.1 Added signature authority guidance 3.2.2 Table 5 New stress signature exceptions 3.2.3 Requires use of Form 1237 for Approvers only 3.2.6 EDCC validation modified consistent with automated release 3.3.3b Deleted since EDCC does not record redlines 3.3 Option for attaching revision index sheet to book form drawings eliminated since it cannot be accommodated App A Eliminated reservation of notes area in A-3 and A-4 App C Deleted – EDRS user guide is now online	2/00
F	3.2.2 Table 5: Added cable sub assembly drawings as an exception for stress signature	5/00
G	Revised and rewritten, Major changes include: 1.5 Added to and updated Applicable Documents, combined with Referenced Documents 2.1.31 Identified Projection System Requirements 2.2 Added Format Number to Title Block to identify software, date, and revision of format Fig. 2 Updated Title Block to identify use of inches, CAGE Code, and FMT 2.2.4 Added capability to use separate parts lists 2.3.24 Clarified detail drawing types and uses. 2.3.2.12.2 Clarified vendors name may only be included as suggested source 2.3.2.12.3 Clarified approvals for interface control drawings. 3.1.2.2 Serial No. assignment for re-fabricated parts with unknown or questionable history begins at 4001. WAS: 5001	8/01

REVISIONS		
VER	CHANGE	DATE
	3.2.1c Added options for entering Checker name Table 4 Updated Approval Signature Required for Engineering Drawings 3.2.4 Clarified Fabrication Approval Drawing procedures 3.2.6 Revised EDCC validation procedures 3.3.1 Clarified options for promoting from FAB Approval to Final Approval 3.3.2 Revised Drawing Change Notice Procedures 3.3.3 Revised Redline Procedures Section 4 Moved Appendix C, Model Control, to create Section 4	
H	1.2 and 1.3 Replaced reference to JMI 8500.2 with JPD 8500.2. 1.4 Added CONTRACTOR COMPLIANCE Section. 1.5.1 Updated compliance date to November 1, 2004. 1.6 Updated reference documents. Note, the updated documents noted in this section are updated throughout the document as well. Removed reference to JPD8500.4 document version. Added DFARS 204.7302. Replaced reference to ANSI/IEEE STD 268-1992 with superseding document IEEE/ASTM-SI-10. Corrected reference to IEEE-91-1984 with ANSI/IEEE-STD-91. Corrected reference to IEEE-200-1975 with IEEE-STD-315-1975. Replaced reference to ISO HB12 with ISO 128-1:2003. Corrected reference to JMI 2200.5 with JMI 2220.5. Replaced reference to MIL-STD-12 with ASME Y14.38. Replaced references to MIL-STD-17-1 and MIL-STD-17-2 with MIL-STD-17. Removed reference to MIL-STD-100 which was cancelled 12/14/01. Added reference to JPD 8500.3 and updated reference to applicable JPD 8500.2. Replace reference to NPG 1441.1 with NPR 1441.1. Replaced reference to NPG 4200.1 with NPR 4200.1. 2.2 Added "S" as format designator for SDRC I-DEAS Master Series software and "W" as format designator for Solidworks software. Added image of title block for subsequent pages on multi-sheet drawings. Updated figure to remove Fracture Critical Block and rename Equipment Type to Drawing Type. 2.2.3 Block A. Replaced reference to MIL-STD-100 with ASME Y14.100. 2.2.3 Block H. Replaced reference to MIL-STD-100 with ASME Y14.100. 2.2.3 Block K. Renamed block from Equipment Type to Drawing Type. The drawing type is used to identify required approvals. Allowable for the values drawing type field are listed in Table 3.2-1. 2.2.3 Block P. Clarified use of next assembly block. 2.2.3 Block L. Removed Fracture Critical Block from title block. Added clarification of date format. Dates shall be entered as M/D/YY or MM/DD/YY. 2.2.4 Replaced incorrect reference to Section 2.2.4.1, #5 with Section 2.2.4.1.e. 2.2.4.3 Updated Parts List Columns to match Separate Parts Lists Columns. Added columns for CAGE Code, Fracture Critical, Traceability Code, Reference Designator, and Flag Notes. 2.2.4.4 Modified Separate Parts Lists Requirements 2.2.4.5 Clarified procedures for revising separate parts list. 2.2.5 Replaced reference to MIL-STD-100 with ASME Y14.100. 2.2.6.2.3 Replaced reference to MIL-STD-100 with ASME Y14.100. 2.2.6.2.4 Deleted Fracture control notes for assemblies and installations. This is now in the parts list. Reference Section 2.2.4.	3/4 ^{3/4}

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	<p>2.2.6.2.6 Serialization or Lot Numbering Notes section added to provide clarification for serialization or lot traceability of hardware</p> <p>2.3.2 Clarified second letter designator are guidelines and not cause for rejection of the drawing.</p> <p>2.3.2.4.2b Clarified requirements for matched parts drawing.</p> <p>2.3.4. Added new equipment code for Bio-Medical equipment type.</p> <p>2.3.72.3.7.0. & 2.3.7.0 Clarified general assignment of dash numbers and mirror image parts</p> <p>2.3.72.3.7.1.2 & 2.3 Clarified use of -3XX and -7XX series</p> <p>2.4.1 Added clarification that EA-WI-027 is the governing document for configuration management requirements for EA engineering projects and removed duplicate wording between JPG 8500.4 and EA-WI-027.</p> <p>3.1 Added lot numbers to numbers controlled by the EDCC.</p> <p>3.1.2 Revised section and sub-sections to clarify lot and serial number assignment. Added Figure 6 and Figure 7.</p> <p>3.2.1 Clarified names and dates for in the title block indicate the person responsible for that specific revision of the drawing. Added further clarification for each role in sub-sections.</p> <p>3.2.2 Clarified Table 3.2-1 indicates minimum approvals required. Added NOTE: If materials certification of components on drawings is required the project shall establish a policy for additional signatures such as materials, stress, or QE.</p> <p>Table 3.2-1 Updated types of drawings and required signatures. Added division level authorization requirement for changing OPR of drawing.</p> <p>3.2.6 Added authorization for EDCC to hold drawings for errors that prevent entry into the DDMS.</p> <p>3.3.2 Block K was added. Dates shall be entered as M/D/YY or MM/DD/YY.</p> <p>4. Revised and Invoked Model Control Section.</p> <p>Appendix B – Revised to examples and table to reflect new parts lists requirements.</p>	
J	<p>Converted document from JSC Policy Guideline (JPG) to JSC Procedural Requirements (JPR). JPR 8500.4 supersedes JPG 8500.4.</p> <p>Note: Document skips Rev “I” per center document revision standard.</p> <p>Acronym Listing – Added CAGE and JPR</p> <p>All Sections - Revised entire document to ensure the following words: shall, should, and will; were used per the definitions in section 1.1. Reworded ambiguous sections and replaced ambiguous words such as: must, may, and recommend. Clarified required use of CAGE Codes.</p> <p>1.1 Added definitions of the following words: shall, should, and will.</p> <p>1.5.1 Updated compliance date to May 1, 2005.</p> <p>2.2 Removed IGES as from format codes. Codes are intended to identify the software tool used to create the drawing. IGES is not a software tool.</p> <p>2.2.3 Block N, Clarified procedure for design organizations to indicate changes to</p>	02/05

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	<p>the standard tolerances</p> <p>2.2.3 Block P, clarified procedure non-JSC next higher assy numbers</p> <p>Error! Reference source not found. Changed separate parts lists header requirements to leave header blank and to require the EDCC to stamp the header at drawing release.</p> <p>2.3.4 Added clarification for equipment types</p> <p>3.1.2 Deleted wording duplicated from JPD 8500.3.</p> <p>Table 3.2-1 Added grid lines to ensure clarity.</p>	
K	<p>1.4 Revised and rewritten to clarify contractor responsibilities for use of EDRS/EDCC or delivery to DDMS.</p> <p>1.4.1, 1.4.3, 2.2.4.1, Appendix B Note 11, & Table B-1 Reworded “Industry Standard.”</p> <p>1.6 Added section defining DDMS, EDCC, and EDRS as well as establishing EDRS and EDCC as part of the DDMS environment.</p> <p>1.7 Referenced Documents section updated.</p> <p>2.1.3.3 Clarified required use of ASME Y14.5M dimensioning and tolerancing practices. Added GD&T as recommended best practice.</p> <p>2.1.3.8 Materials and Processes, new subsection added.</p> <p>2.2.4 Added requirements for types of drawings which require parts lists.</p> <p>2.2.4.2 Added parts lists exemption for CCCD/SSCCD.</p> <p>2.2.4.3 Made more columns optional on integral parts list.</p> <p>2.3.2.9.5 Added section defining drawing tree and approvals required</p> <p>2.3.2.9.9 and 2.3.2.9.10 Added instructions for use of Source and Specification Control drawing or part numbers in the parts list for the next assembly drawing.</p> <p>2.2.4.3.h, 2.2.6.2.6, 2.2.6.2.6.b, 3.1.2.1, 3.1.2.2, & 3.1.2.3 Clarified Trace Code use.</p> <p>2.2.6.1.3 Changed flag note size requirements from “between .5” and .63” tall” to “proportional to text height”</p> <p>2.2.4.5 Clarified SPL submittal requirements for Revisions and DCNs.</p> <p>2.2.6.2.2.1 MIP Usage added.</p> <p>2.2.6.2.3 Deleted Suitability Notes Section because other available notes handle the previously stated use.</p> <p>2.2.6.2.4 Updated Fracture Control section.</p> <p>2.3.2.5.4 Altered Item Assembly Drawings section added</p> <p>2.3.2.9.5 replaced “approval signatures” with “drawing approvals”</p> <p>2.3.3 Added new program letter “H” for Constellation Program and “W” for Institutional Programs (including facilities)</p> <p>2.3.7 c Added link to Table SHEET 1 OF 1</p> <p>Table B-7. Separate Parts List Example – Tabulated Detail Part Drawing with Bulk Item</p> <p>2.3.7 Clarified and renumbered dash numbered requirements.</p> <p>2.3.7.1 through 2.3.7.6.2.2 Corrected sections numbers and added appropriate titles.</p> <p>2.3.7.1 through 2.3.7.1.8 Added these sections.</p> <p>3.1.2 Clarified serial and lot number tracking and assignment.</p> <p>3.2.1 Replaced “signature” with “approval”</p>	

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	<p>3.2.1.3 Replaced “signature” with “checker”</p> <p>3.2.1.4 Updated approver responsibilities</p> <p>3.2.1.7 Replaced “signature” with “approval”</p> <p>3.2.2 Replaced “signature” with “approval”</p> <p>3.2.3 Changed from Signature Verification to Approval Verification</p> <p>3.2.3 Replaced “determining the validity of drawing review signatures” with “approved drawing reviewers”</p> <p>3.2.4 Replaced “approved” with “reviewed,” “signing” with “approving,” and “approval signatures” with “reviewers”</p> <p>3.2.6 Bullets a, g, h, j, and k, references were replaced with correct cross references.</p> <p>3.3.1 & 3.3.2 Clarified wording on required approvals for revisions and DCNs. Refer to Table 3.2-1. Modified “Description of Change Block” to “Revision history block”</p> <p>3.3.2 Replaced “signature” with “approver(s)”</p> <p>3.3.2 Changed 10 DCN limit requirement to 5 and added clarification.</p> <p>3.5 through 3.5.2 revised text to include transfer of drawings from NASA to contractor.</p> <p>3.5 through 3.5.2 replaced discussing government drawings furnished to a contractor.</p> <p>3.5.3 through 3.5.5 added sections to include transfer of drawings.</p> <p>4 through 4.4.3 replaced – concerning CAD file control.</p> <p>Table 2.3-1 Revised.</p> <p>Table 2.3-2 Converted from text to table.</p> <p>Table 2.3-3 Added.</p> <p>Table 2.3-4 Added.</p> <p>Table 3.2-1 Renamed “Flight Portable Photo Equip” to “Flight Portable COTS A/V Equip”. Renamed “Flight/GSE Cable SubAssy” to “Flight/GSE Electrical Cable”. Renamed “Flight C CCD” to “Flight C CCD/SSCCD”. In the footnote “Section O”, changed signatures to approvals. Changed reference for JSC civil servants and contractors. Modified “Design Ready for Configuration Control” to “Drawing Ready for Review”. In footnote Block H, replaced “approval signatures” with “approvals”</p> <p>Figure 2.3-1 JSC Drawing and Part Number Format revised</p> <p>Figure 4.4-1. JSC CAD File Workflow replaced</p> <p>Figure A-1 Drawing Format for Size A (Portrait) replaced</p> <p>Figure A-2 Drawing Format for Size A (Landscape) replaced</p> <p>Figure A-3. Drawing Format for Size B and C replaced</p> <p>Figure A-4. Drawing Format for Size D, E, and F and Redline Example replaced</p> <p>Table B-1 Clarified use of CAGE Codes.</p> <p>Table B-4 Showed sheet zone symbol.</p> <p>Table B-5 Replaced hyperlink.</p> <p>Table B-6 Replaced hyperlink.</p> <p>Table B-7 Separate Parts List Example – Tabulated Detail Part Drawing with Bulk Item</p> <p>Table B-8 Added table.</p> <p>Appendix A Added table for the second letter designators in the numbering</p>	

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	<p>section.</p> <p>Appendix C Added this appendix and referenced it in Section 3.2.2.</p> <p>All table and figure numbers were changed to include the section number as a prefix to the figure and table number.</p> <p>All references to EDRS, EDCC, and DDMS were reviewed to determine if they were correct. EDRS references were reviewed to ensure they were generic enough to allow migration of the EDRS into DDMS.</p>	

All previous versions of the Engineering Drawing System Manual may be found in the Design and Data Management System. Search DDMS for the number, **8500.4**, and the version of the document.

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ACRONYM LISTING

AIA	Aerospace Industries Association
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
CAD	Computer-Aided Design
CAGE	Commercial and Government Entity
CCB	Configuration Control Board
CCCD	Crew Compartment Configuration Drawing
CM	Configuration Management
COTR	Contracting Officer's Technical Representative
COTS	Commercial Off-the-Shelf
CR	Change Request
DCN	Drawing Change Notice
DDMS	Design and Data Management System
DFARs	Defense Federal Acquisition Regulations
DLA	Defense Logistics Agency
DR	Discrepancy Report
DRD	Data Requirement Description
DRL	Data Requirement List
EDCC	Engineering Drawing Control Center
EDRS	Electronic Drawing Review System
GD&T	Geometric Dimensioning & Tolerancing
GFE	Government-Furnished Equipment
GSE	Ground Support Equipment
ICD	Interface Control Document
IEEE	Institute of Electrical and Electronic Engineers
ISO	International Organization for Standardization
JHB	JSC Handbook
JMI	JSC Management Instruction
JPD	JSC Policy Directive

ACRONYMS, continued

JPG	JSC Procedural Guideline
JPR	JSC Procedural Requirements
MIP	Mandatory Inspection Point
N/A	Not Applicable
NASA-STD	NASA Standard
NDE	Non-Destructive Evaluation
NDT	Non-Destructive Testing
OPR	Office of Primary Responsibility
QAR	Quality Assurance Representative
SAE	Society of Automotive Engineers
SDRC	Structural Dynamics Research Corporation
SI	International System of Units
SPL	Separate Parts List
SR&QA	Safety, Reliability and Quality Assurance
WI	Work Instruction

ABBREVIATIONS

N/A	Not Applicable
APP	Approval
AR	As Required
FAB APP	Fabrication Approval
FINAL APP	Final Approval
FMT	Format
FRAC CRIT	Fracture Critical
MIL SPEC	military specification
MIL-STD	Military Standard
NC	No Change
QTY	Quantity
REF	Reference

OTHER TERMS

DR	Drafter
ENG	Engineer
CH	Checker
APP	Approver
QE	Quality
STRESS	Stress
MATL	Material
AUTH	Authorizer
TS	Trace Code – Serial Number
TL	Trace Code – Lot Number
TM	Trace Code – Serial and Lot numbers required
TE	Trace Code – Exempt
FAB	Fabrication

1 ADMINISTRATIVE PROCEDURES

1.1 POLICY

The Engineering Drawing System Manual establishes the procedures to follow when preparing, releasing, maintaining, and controlling engineering drawings and associated files. These procedures are intended to ensure a standard drawing format and to ensure that changes to released drawings are documented and approved.

The following definitions differentiate between requirements and other statements.

Shall:	This verb is used for stating binding requirements.
Should:	This verb is used for stating non-mandatory goals.
Will:	This verb is used for stating facts or declaration of purpose.

1.2 APPLICABILITY

The JSC Policy Directive JPD 8500.2 defines applicability of this document.

NOTE: All JSC numbered drawings (See Section 2.3) shall be released through the EDCC.

1.3 RESPONSIBILITIES

The JSC Policy Directive JPD 8500.2 defines responsibilities.

1.4 CONTRACTOR COMPLIANCE

1.4.1 Contractor Releasing to EDRS/EDCC with Approved OPR

This section outlines requirements for contractor compliance if the contractor releases JSC drawings with JSC numbers through the EDRS/EDCC.

1.4.1.1 Contractor Level of Effort Tasks Releasing through EDCC/EDRS

For level of effort tasks, contractors shall use the JSC CAGE code.

1.4.1.2 Contractor Completion Form Task Releasing through EDCC/EDRS

For completion form tasks, contractors shall use their own CAGE codes on the drawings rather than the JSC CAGE code.

Contractors releasing drawings through the EDRS/EDCC shall adhere to the requirements as defined in JPR 8500.4.

To use a contractor CAGE code, the COTR of that contract shall provide a written request to the EDCC listing the following:

- Contractor name and CAGE Code. The EDCC shall assign an OPR code to that contractor for issuing EDCC drawing numbers, and EDRS drawing approval authority. EDCC shall maintain a list of all approved contractor OPR codes.

- List of contractor personnel authorized to sign the JF1237 requests for that Contractor. Refer to Section 3.2.3.

1.4.2 Contractor Delivering to DDMS

This section outlines requirements for contractor compliance if the GFE drawings and associated files are delivered to the Design and Data Management System (DDMS) rather than released through the EDRS/EDCC.

1.4.2.1 Contractor Configuration Management

Prior to delivery, the contractor shall maintain revision and release configuration control of his or her drawings and associated files. The contractor internal engineering drawing practice standard shall be consistent with a NASA/JSC accepted standard such as ASME Y14.100. Contractor's drawing standard acceptance shall be delineated in the NASA contract or written NASA/Contractor agreement. The Contractor drawing standard shall be made available upon request for NASA audit. If an audit is requested, the Systems Engineering Office from the Engineering Directorate shall perform the audit. The contractor's approval cycle shall include technical discipline review and approval that meets the intent of the drawing content reviews defined in Section 3.2 and Table 3.2-1. Note: The contractor is responsible for certifying internal technical reviewers.

1.4.2.2 Drawing and Part Numbers

The contractor shall not use JSC drawing or part numbers if the GFE drawings and associated files are delivered to the DDMS rather than released through the EDCC. However, the contractor numbering scheme shall use dash numbers. The contractor is not required to use the JSC dash numbering scheme. Refer to Section 2.3 for information on JSC Numbers.

1.4.2.3 Contractor Specifications and Processes

Restrictions defined in Section 2.1.3.8 for material and process callouts also apply to drawings and associated files delivered to the DDMS rather than released through the EDRS/EDCC.

1.4.2.4 Drawing Delivery

The contractor shall deliver all drawings, Separate Parts Lists (SPLs) and meta-data electronically in a format compatible with the DDMS. Drawing delivery shall include any change notices or engineering orders which modify the drawing. The meta-data encompasses attributes required to enter a record in the system. Address questions regarding format and required meta-data to the DDMS Engineering project manager.

1.4.2.5 Required Associated Files Delivery

For each drawing submitted, the contractor shall submit electronically all files in the native format required to open and modify the drawing in its native format. The

contractor shall not convert the associated files in any way from the native format. In addition, any required associated documents for assembly and/or manufacture shall be delivered. For example, an assembly drawing in Pro/Engineer requires the following file types.

- a. .drw – This is the drawing file. However, it cannot be opened without the model and drawing format files
- b. .asm – This is the assembly model. However it cannot be opened with out all the part models
- c. .prt – All the individual parts that make up the assembly.
- d. .frm – This is the drawing format file or template required to open the drawing file. Format delivery is not required if the JSC standard Pro/E template format is used.

Address questions regarding electronic delivery and formats to the DDMS Engineering project manager. Note, it is not a requirement to use the model naming convention outlined in Section 4.2. However, if the JSC specified model naming convention is not used, the contractor shall provide information to interpret all associated file relationships to specific part and drawing numbers in order to facilitate use of the delivered native files.

1.4.2.6 DDMS Parts List Data Delivery

For each drawing submitted, the contractor shall deliver a Separate Parts List (SPL) per the format defined in Section 2.2.4.4 to support automated procedures for entering part data into the DDMS database. The SPL contains all the data required to create product records and product structure. The contractor may, in addition to providing the SPL, also show a traditional parts list on the face of the drawing (integral parts list) if desired. The integral and separate parts lists shall have identical information. DDMS will treat the SPL as the master to populate the DDMS.

1.4.2.6.1 Parts List Data Format

For each drawing submitted, the contractor shall deliver data in a format compatible with data entry in DDMS. The data delivered will be used to create parts and indented parts list in DDMS. Contact the DDMS Engineering project manager for the data formats allowed.

1.4.2.6.1.1 Alternate Format for Parts List Data

If there is no DDMS compatible data entry format available, the contractor shall deliver a Separate Parts List (SPL) format as defined in Section 2.2.4.4. The contractor may, in addition to providing the SPL, also show a traditional parts list on the face of the drawing (integral parts list) provided that the requirement in Section 1.4.2.6 is met.

1.4.2.6.2 Parts List Data Master

The contractor provided data shall have identical information to the drawing parts list. DDMS will treat the contractor provided data file as the master to populate the DDMS.

1.4.2.7 Serial and/or Lot Number Records

If the contractor is manufacturing the hardware depicted on the drawings, a list of serial and/or lot numbers assigned for each part, if applicable, shall be provided. The contractor is not required to use the JSC numbering and lettering scheme for serial and lot numbers. However, the contractor shall adhere to uniqueness requirements as outlined in Section 3.1.2.

Address questions regarding electronic delivery and format serial/lot number list to the Design and Data Management System (DDMS) Engineering project manager.

1.5 IMPLEMENTATION

1.5.1 Compliance

1.5.1.1 Contractors

For contractors with a specific revision of JPG 8500.4 or JPR 8500.4 invoked in an existing contract, that revision shall remain in effect until the contract is modified. For contractors with “latest revision” of JPG 8500.4 or JPR 8500.4 invoked in an existing contract, this revision K of JPR 8500.4 shall be in effect as of the date of its approval and drawing compliance shall be as of the date specified in paragraph 1.5.1.3 below. For contractors with JPR 8500.4 invoked in new contracts, this revision K of JPR 8500.4 shall be in effect as of the date of its approval and drawing compliance shall be as of the date specified in paragraph 1.5.1.3 below.

1.5.1.2 Civil servants

For civil servants, this Revision K of JPR 8500.4 shall be in effect as of the date of its approval and drawing compliance shall be as of the date specified in paragraph 1.5.1.3 below.

1.5.1.3 Drawing compliance deadline

Drawings submitted to the EDCC or DDMS after April 1, 2006, shall be submitted in full compliance with all requirements of this Revision K of JPR 8500.4 unless exempted elsewhere in this document. For drawing compliance the previous Revision J of JPG 8500.4 is applicable until this date.

1.5.2 Paper Drawings

The EDCC shall not accept paper documents for JSC numbered drawings. If a JSC organization requires the archival of paper documents for non-JSC numbered drawings, the drawings may be scanned electronically and submitted to the DDMS. Refer to Section 2.3 for information on JSC numbers.

1.6 DDMS, EDCC, and EDRS

References to the Design and Data Management System (DDMS), the Engineering Drawing Control Center (EDCC), and the Engineering Drawing Review System (EDRS) are used throughout this document.

The DDMS is an engineering environment comprised of multiple systems with the purpose of configuration managing and warehousing design data. In the context of this document, DDMS design data includes drawings, CAD models associated with drawings, part hierarchical relationships (parts list and next assemblies), as well as attributes such as drawing numbers, CAGE Codes, serial numbers, part names, drawing titles, etc.

In the context of this document, the EDCC refers to the following:

- 1) the organization which performs duties associated with drawing control.
Responsibilities of the EDCC organization are established in JPD 8500.2, JPD 8500.3, and JPR 8500.4.
- 2) the database which stores drawings as well as attributes related to those drawings such as drawing number, revision, and serial numbers
- 3) the website which allows users to access the database. The EDCC database and website are part of the DDMS environment.

In the context of this document, the EDRS refers to the system used for electronic drawing review and approval. Drawings approved through EDRS are released into the EDCC database. This document provides the functional requirements for the system. The EDRS is part of the DDMS environment.

1.7 REFERENCED DOCUMENTS

Adhere to the latest revisions of the following documents invoked as part of JPR 8500.4 when generating engineering drawings. If an applicable or referenced document has been superseded, the superseding document shall take precedence. In case of conflict between JPR 8500.4 and an applicable document (other than Title 36 of the Code of Federal Regulations, Chapter XII, Part 1234), JPR 8500.4 shall take precedence. In case of conflict between JPR 8500.4 and Title 36 of the Code of Federal Regulations, Chapter XII, Part 1234, Part 1234 shall take precedence.

ANSI/EEE Std 260.3	Mathematical Signs and Symbols for Use in Physical Sciences and Technology
ANSI-B4.2	Preferred Metric Limits and Fits
ANSI/IEEE-STD-91	IEEE Standard Graphic Symbols for Logic Functions
ASME B46.1	Surface Texture (Surface Roughness, Waviness and Lay)
ASME Y14.1	Decimal Inch Drawing Sheet Size and Format
ASME Y14.2M	Line Conventions and Lettering
ASME Y14.3	Multi-view and Sectional View Drawings

ASME Y14.5M-1994	Dimensioning and Tolerancing
ASME Y14.24	Types and Applications of Engineering Drawings
ASME Y14.34M	Associated Lists
ASME Y14.35M	Revision of Engineering Drawings and Associated Documents
ASME Y14.38a	Abbreviations and Acronyms
ASME Y14.100	Engineering Drawing Practices
ANSI/AWS-A2.4	Standard Symbols for Welding, Brazing, and Nondestructive Examination
DFARS 204.7302	Defense Federal Acquisition Regulation Supplement subpart 204.7302
EA-WI-027	Configuration Management Requirements
IEEE-STD-315-1975	IEEE Graphic Symbols for Electrical and Electronic Diagrams (Including Reference Designation Letters) Bound with 315A-1986 (R1993) Supplement to IEEE-STD-315-1986
IEEE/ASTM SI 10	American National Standard for Use of the International system of Units (SI): The Modern Metric System
ISO 128-1	Technical drawings—General Principles of Presentation
ISO 5457	Technical Product Documentation - Sizes and Layout of Drawing Sheets
JHB 1600.3	JSC Security Manual
JMI 2220.5	Use of the International System of Units
JPD 8500.2	JSC Engineering Drawing System
JPD 8500.3	Serial and Lot Numbers for Certain Items of Government-Furnished Equipment
JSC 61231	Engineering Drawing Requirements for Composite Structures
MIL-STD-17	Mechanical Symbols for Aeronautical, Aerospacecraft, and Spacecraft Use
NASA/JSC PRC-9002	Process Specification for Part Marking
NPR 1441.1	NASA Records Retention Schedules
NPR 4200.1	NASA Equipment Management Manual
SKZ36103755	JSC Fabrication Tolerances and Practices
Title 36 of the Code of Federal Regulations, Chapter XII, Part 1234	Electronic Records Management

Nationally recognized standards governing use of symbols on engineering drawings and associated lists are shown in Table 1.7-1.

Table 1.7-1. References for Standard Symbols

Electrical and Electronic	IEEE-STD-315-1975	IEEE Graphic Symbols for Electrical and Electronic Diagrams (Including Reference Designation Letters) Bound with 315A-1986 (R1993) Supplement to IEEE-STD-315-1986
Mechanical	MIL-STD-17	Mechanical symbols for Aeronautical, Aerospace-craft and Spacecraft use.
Welding and NDT	ANSI/AWS-A2.4	Standard Symbols for Welding, Brazing, and Nondestructive Examination
Mathematical	ANSI/EEE Std 260.3	Mathematical Signs and Symbols for Use in Physical Sciences and Technology
Logic	ANSI/IEEE-STD-91	IEEE Standard Graphic Symbols for Logic Functions

2 JSC ENGINEERING DRAWING REQUIREMENTS

2.1 BASIC REQUIREMENTS

2.1.1 Purpose of Drawings

The purpose of drawings is to convey sufficient engineering requirements, characteristics, and information to manufacture, install, or procure an item or to procure materials or services. Ensure that drawings are complete for the purpose intended. Provide drawings that are easily and completely understandable by craftsmen, production planners, buyers, and others who must use the drawing.

2.1.2 Legibility

Create line work that is sharply defined and of uniform density, with clear and adequately spaced lettering. Produce line work and lettering that are opaque enough to be legible in full-size or reduced-size copies prepared by a generally accepted method of reproduction. Find guidelines for line conventions and lettering in ASME Y14.2M.

2.1.3 General Drawing Practice

Prepare drawings in accordance with ASME Y14.100.

2.1.3.1 Projection System

ASME Y14.3M delineates projection system definitions. In general, use third-angle projection on JSC drawings. Use first-angle projection drawings only if they are identified as such and program approval has been established.

Establish projection system identification with text stating the type of system used, adjacent to a graphic symbol (per ASME Y14.3M), located near the title block.

Third-angle projection drawings need not be identified, although it is recommended that drawings to be viewed internationally should have the particular system identified.

2.1.3.2 Specification of General Fabrication Practices

It is recommended that drawings for fabrication specify, as a general note, SKZ36103755. This document defines numerous tolerances and shop practices to be used in lieu of explicit drawing callouts.

2.1.3.3 Dimensions and Tolerances

The design organization shall use dimensioning and tolerancing practices as specified in ASME Y14.5M-1994.

The recommended best practice for dimensioning and tolerancing is to use geometric dimensioning and tolerancing where appropriate.

Design organizations may also use general dimensioning practices as defined in ASME Y14.5M. Drawing dimensions are in English units unless otherwise specified. When applicable, use SI Units in accordance with IEEE/ASTM-SI-10.

2.1.3.4 Surface Texture, Roughness, Waviness, and Lay

Surface texture, roughness, waviness, and lay requirements shall be as specified in ASME B46.1.

2.1.3.5 Abbreviations

Use abbreviations that conform to those listed in ASME Y14.38. Nonstandard abbreviations are not allowed.

2.1.3.6 Standard Symbols

2.1.3.6.1 Standards

Nationally recognized standards governing use of symbols on engineering drawings and associated lists are shown in Table 2.1-1.

Table 2.1-1. References for Standard Symbols

Electrical and Electronic	IEEE-STD-315-1975	IEEE Graphic Symbols for Electrical and Electronic Diagrams (Including Reference Designation Letters) Bound with 315A-1986 (R1993) Supplement to IEEE-STD-315-1986
Mechanical	MIL-STD-17	Mechanical Symbols for Aeronautical, Aerospacecraft, and Spacecraft Use
Welding and NDT	AWS- A2.4	Standard Symbols for Welding, Brazing, and Nondestructive Examination
Mathematical	ANSI Y10.20	Mathematical Signs and Symbols for Use in Physical Sciences and Technology
Logic	ANSI/IEEE-STD-91	IEEE Standard Graphic Symbols for Logic Functions

2.1.3.6.2 Symbols Not Covered by Standards

When symbolic representation is required for items not covered by the standards shown in Table 2.1-1, select symbols from standards issued by the American Standards Association or by national engineering societies; other symbols may be devised by the design activity. However, when using symbols that are not covered by standards, the design activity shall explain the meaning of each of these symbols by a general note on the drawing.

2.1.3.7 Drawing Guidelines for Composite Material

Produce drawings of composite laminate material in accordance with JSC 61231.

2.1.3.8 Materials and Processes

Manufacturing/assembly processes, commercial hardware, and standard hardware (e.g. fasteners, etc.) called out on the drawings shall not be defined by contractor in-house specifications but rather by publicly available standards maintained by the military, government, or standards committee/institution (e.g. MS, NAS, SAE, ASTM, ASME, etc.). When available, JSC standards and processes are preferred over all other processes. The following exceptions are allowed only for standards and processes, not hardware (e.g. fasteners, etc.):

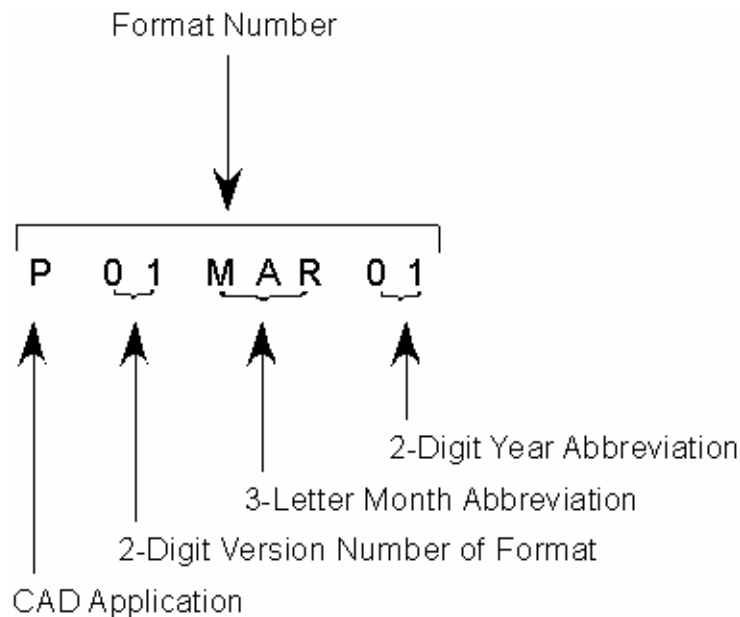
- Specific processes which are proprietary that can only be performed by the contractor.
- A contractor non-proprietary standard or process may only be used with specific approval by the COTR. The full standard or process shall be delivered to DDMS and linked to the part in DDMS.

2.2 SIZE AND FORMAT

All JSC drawings shall conform to the sizes and formats defined in this document. The EDCC shall make EDRS-compatible formats, with a seven-character-code format number, electronically available (Example: P01MAR01, Figure 2.2-1).

New drawings shall use the latest revision of the format within six months of the revision date of the format. Revised drawings previously electronically released in EDRS/EDCC may use previous EDRS-compatible formats.

Figure 2.2-1. Format Number



- The first character is a one-letter abbreviation of the software used to create the format, as identified below. Contact the EDCC for additional abbreviations.
 - A – AutoCAD
 - M – MSWord
 - O – OrCAD
 - P – Pro/E
 - S – SDRC I-DEAS (Master Series)
 - U – Unigraphics
 - W - Solidworks
- The second two characters are the numerical version of the format, starting with 01.
- The next three characters are the three-letter abbreviation of the month the format was revised.
- The final two characters designate the year the format was revised.

2.2.1 Drawing Sizes

For the English system, use finished sheet format sizes and the size-designating letters as shown in ASME Y14.1. The EDCC provides electronic standard formats described in

Table 2.2-1 below. Select sheet sizes to provide well-arranged drawings with adequate allowance for future revisions and added material at the discretion of the draftsman. Size A sheets are intended for use in parts lists, book-form, tabulated, or specification drawings; avoid their use for other purposes. Multi-sheet drawings in Sizes A, B, C, D, E, and F are permissible and should be used when practicable in preference to roll-size drawings; however, roll-size drawings (J size) may be used when necessary.

For the metric system, if the drawing is created using metric units, use the English drawing formats (due to a current system limitation with EDRS). Drawing originators shall address the tolerance block and indicate use of metric units.

Table 2.2-1. JSC Standard Drawing Sizes (English)

Size Code	Width x Length (in)	See Example in Appendix A
A	11 x 8.5	A-1
A	8.5 x 11	A-2
B	11 x 17	A-3
C	17 x 22	
D	22 x 34	A-4
E	34 x 44	
F	28 x 40	
J	34 x AR	
		-

2.2.2 Basic Sheet Format

For the English system, use the general format and arrangement of data on drawings as shown in Appendix A. The reserved areas illustrated are recommended allowances for future additions and revisions, and are neither mandatory nor intended to be restrictive.

For the metric system, adhere to International Standard ISO 5457 for the general arrangement of data on drawings.

2.2.3 Title Block

The basic drawing title block in the lower right-hand corner of each drawing is illustrated in Figure 2.2-2. Include the continuation sheet title block on subsequent sheets of a multi-sheet drawing per Figure 2.2-2. Find guidelines for lettering of title block entries in ASME Y14.2M. Complete the title blocks as follows in Figure 2.2-2:

Figure 2.2-2. Format of the Title Blocks

UNLESS NOTED OTHERWISE DIM ARE IN INCHES, TOL ARE: .0 ± .1 .000 ± .005 .00 ± .02 ANGULAR ± .5° SURFACE FINISH IN MICROINCHES RMS UNLESS NOTED OTHERWISE ✓ NEXT ASSY	SIGNATURES		DATE		NATIONAL AERONAUTICS AND SPACE ADMINISTRATION			
	DR				LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS			
	ENG				A			
	CH							
	APP							
	GE				PROJECT			
	MATL				B			
	STRESS				SIZE	CAGE CODE	DWG NO	REV
	AUTH					21356		
DRAWING TYPE					SCALE	ORG	FMT	SHEET OF

Callout letters: N (top left), M (left), O (top left), L (top left), P (middle left), Q (middle left), K (bottom left), J (bottom), G (bottom), H (bottom), I (bottom), F (bottom), R (bottom), E (bottom), D (bottom right), C (bottom right), B (bottom right), A (bottom right).

First Page Title Block

SIZE	CAGE CODE	DWG NO.	REV
SCALE:	ORG	FMT	SHEET OF

Multi-sheet Title Block

- Block A is reserved for the drawing title. The guide for drawing titles and other title block entries is ASME Y14.100.
- Block B is reserved for the project name.
- Block C is reserved for the drawing number as specified in Section 2.3.
- Block D is reserved for revision letter for Final Approval drawings or revision number for Fabrication Approval drawings. (Important: Leave this block empty; the EDCC shall fill it out.)
- Block E designates how many sheets the drawing has (example: 1 of 1, 2 of 4).
- Block F is reserved for the OPR code of record identified in the EDCC for the specified drawing number (example: ES or EC2).
- Block G indicates letter size of the drawing.
- Block H is reserved to show scale of drawing and is to be designated by the fractional method as illustrated in ASME Y14.100.
- Block I is reserved for the commercial and government entity (CAGE) code identification number as specified in the Defense Logistics Information Service website, http://www.dlis.dla.mil/cage_welcome.asp. The number to be used by all JSC civil servants is 21356. Refer to Section 1.4 for CAGE code to be used by contractors.
- Block J is reserved for the official release stamp.
- Block K provides for identification of the drawing type. The drawing type is used to identify required approvals. Allowable values for the drawing type field are listed in Table 3.2-1. For example, enter "Flight Schematics" in this block.
- Block L is reserved for the date (see Section 3.2.1). Dates shall be entered as M/D/YY or MM/DD/YY (e.g., March 1, 2004 would be 3/1/04, or 03/01/04).

- Block M is reserved for surface finish. (see Section 2.1.3.4)
- Block N specifies JSC standard tolerances. These values shall not be changed. If the originating organization wishes to use different values, the design organization shall cross out the block and indicate the new tolerances for that drawing with another table or flag note.
- Block O designates blocks for: drafter, design engineer, checker, org. official's approval, stress, quality engineering, materials & processes, & optional approving authority. Approvals always apply to the latest revision. (see Section 3.2.1) The heading for these approvals may be labeled either SIGNATURES or APPROVALS.
- Block P is reserved for drawing number of next higher assembly drawing. Use "N/A" if next higher assembly is not applicable. Multiple next assemblies shall be separated by commas. If multiple next assemblies will not fit in this block, indicate with a flag note or application block per ASME Y14.100. For application block, use "SEE APPLICATION BLOCK" in Block P. For non-JSC next higher assembly numbers, the vendor number shall be entered in the block and the vendor CAGE Code shall be called out using a flag note. Additional information such as vendor name and address may be provided as a flag note. If the next assembly is a pick list, enter the document number of the pick list.
- Block Q is available for additional information.
- Block R specifies the format identification number. (see Section 2.2)

2.2.4 Parts List

The following is a list of requirements and guidelines for parts list creation and entry.

- a. Detail drawings (type "D"), Assembly drawings (type "E"), Installation drawings (type "G") and Kit drawings (type "J") shall have a parts list showing a complete list of components that go into the top level item being defined on the drawing.
- b. Specification control drawings and source control drawings (type "L") shall have a parts list if multiple configurations are defined on the drawing.
- c. All other drawing types may have a parts list but it is not required.
- d. The parts list may be on the drawing (integral) or prepared as a separate parts list associated with the drawing.
- e. Do not specify materials in the drawing notes unless they meet one of the exceptions noted in Section 2.2.4.1e, below.
- f. When a specification without a revision designation is referenced in the parts list, the latest revision of that specification shall apply. Note: An assembly, subassembly or detailed part is simply referred to in this section as a "part."

2.2.4.1 Parts List Entry Items

If possible, organize the parts list into subsets in the following order. For integral parts lists, arrange subsets in order from the bottom to the top. For separate parts lists, arrange subsets in order from top to bottom. List each subset in alphanumeric ascending order from the bottom to the top on integral parts lists and from top to bottom on separate parts lists. Several spaces can be left between each subset if desired to allow for later additions. See examples in Appendix B.

- a. JSC in-house parts
 - 1) Unit assemblies (i.e. -301, -302, -701, etc.)

- 2) Detail parts (i.e. -001, 002, -003, etc.)
- 3) JSC components (i.e. SDDXXXXXXXX-XXX, SEDXXXXXXXX-XXX, etc.)
- b. Other NASA center parts or NASA contractor parts
- c. Parts design controlled by publicly available standards maintained by the government, military, or standards committee/institution (e.g. AN, AS, MS, NAS, DIN, ISO, SAE, ASTM, ASME, etc.).
- d. Parts design controlled by private vendors (e.g. commercial-off-the-shelf parts (COTS) Products, contractor designed parts).
- e. Bulk materials

2.2.4.2 Parts Lists Entry Requirements

See detailed matrix in Appendix B. CCCD and SSCCD drawings are exempt from parts lists requirements.

2.2.4.3 Integral Parts List Columns

The mandatory columns for an integral parts list are as follows (located from left to right):

- a. Quantity required - labeled "QTY" or "-XXX" (dash number of the assembly)
- b. CAGE Code – Note: This is the CAGE Code for the organization responsible for design of the part, not the manufacture of the part. Manufacturing CAGE codes will be tracked against "As Built" records not on drawings. See Appendix B for further clarification.
- c. Part number
- d. Description
- e. Material
- f. Specification – labeled "SPECIFICATION" or "SPEC"
- g. Fracture Critical – labeled "FRAC CRIT"
- h. Trace Code – labeled "TRACE CODE"

The following additional optional columns may be added to the parts list to the right of the "TRACE CODE" column:

- Locating zone – labeled "ZONE"
- Reference Designator – labeled "REF DES"
- Find (item) number – labeled "F/N" or "ITEM"
- Flag Notes – This column is used to list the numbers of the flag note(s) which indicate information specific to that item. Do not include the flag note symbol.

2.2.4.4 Additional Requirements for Separate Parts List

Separate parts lists will serve two purposes. First, it allows flexibility in creation of the parts list. Second, it allows the part data to be electronically captured by the DDMS and displayed as an indented parts list.

If the parts list is a separate file, insert “SEE SEPARATE PARTS LIST” above the title block of the associated engineering drawing in the location reserved for the parts list. For an approximate location of the standard parts list placement, see Appendix A.

The mandatory columns for the separate parts list are as follows (the listed order shall be displayed from left to right). All columns listed shall remain on the parts list regardless of whether they are used. For example, if the Zone column is not used, a blank Zone column shall remain in the spreadsheet as a placeholder. The column order is critical in order to load the information properly in the DDMS.

- a. ITEM
- b. Quantity required - labeled “QTY” or “-XXX” for multi-dash assemblies on the same parts list (dash number of the assembly). Drawings with multiple dash numbers may be depicted on a single sheet with multiple quantity columns or multiple sheets with one or more quantity columns. See Appendix B for examples.
- c. CAGE CODE – Note: This is the CAGE Code for the organization responsible for design of the part, not the manufacturer of the part. Manufacturing CAGE codes will be tracked against “As Built” records not on drawings. See Appendix B for further clarification.
- d. PART NUMBER
- e. DESCRIPTION
- f. MATERIAL
- g. SPECIFICATION
- h. FRAC CRIT
- i. TRACE CODE
- j. REF DES
- k. ZONE
- l. FLAG NOTES

2.2.4.4.1 Format Requirements

The format for a separate parts list is as follows (also see Appendix B):

- a. The separate parts list is in landscape format. Get templates through the EDCC web page (<http://edcc.jsc.nasa.gov/>).
- b. The following items shall be stamped on the header of the SPL by the EDRS. Users shall leave the header blank upon submission of the SPL to EDRS.

- i. company name centered in header (Use NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, LYNDON B. JOHNSON SPACE CENTER for JSC users and contractors releasing to the EDCC)
 - ii. "Parts List" heading in upper left corner
 - iii. drawing number in upper left corner of header under "Parts List" heading
 - iv. drawing title in upper left corner of header under drawing number
 - v. drawing revision designator and DCN sequence number
 - vi. EDCC release stamp (FAB APP or FINAL APP)
 - vii. drawing release date
 - viii. item entries as listed above
- c. The drawing submitter shall verify the sheet count is displayed correctly in the lower right corner of footer.

2.2.4.4.2 User Requirements for Releasing to the EDCC

- a. Get templates through the EDCC web page (<http://edcc.jsc.nasa.gov/>).
- b. The originating organization shall leave blank the 1.25" top margin on the parts list. This area shall be stamped by the EDRS with the header information. Reference Appendix B.
- c. Submit the parts list electronically to the EDCC using the EDRS by creating a drawing review package with the drawing and its separate parts list. Contact the EDCC supervisor for submission instructions.

2.2.4.4.3 EDCC Requirements

- a. Provide templates through the EDCC web page.
- b. Ensure that the released parts list is electronically available through the EDCC web page, as well as its associated engineering drawing.

2.2.4.5 Revisions to Separate Parts List

Separate parts lists may be modified by revising the drawing (See Section 3.3.1) or using a DCN (see Section 3.3.2). Separate parts list cannot be modified independent of the drawing. Once a separate parts list has been submitted with a drawing, all future revisions of the drawing or DCNs submitted to EDRS shall include an updated separate parts list even if changes are required to the associated engineering drawing only. A new updated separate parts list shall be submitted along with the revised drawing or DCN. EDCC will stamp the new SPL with the latest revision designator and DCN count.

2.2.5 Drawing Titles

Create drawing titles that conform to the procedures for creating title block nomenclature entries for drawings and for parts detailed thereon as specified in ASME Y14.100.

2.2.6 Drawing Notes

Drawing notes are used to show requirements, provide supplemental information, avoid repetition of information, avoid congestion on the drawing field, and otherwise ensure completeness and clarity of the drawing.

In JSC drawings that reference specifications, reference approved specifications. When referencing specifications in notes, indicate the specification number. The complete specification title is optional. Assume the latest revision of a referenced specification unless noted otherwise. The specification revision letter is not required on the drawing. In process notes, reference NASA/JSC PRC specifications where available. Contact the Materials and Processes Branch Chief for exceptions.

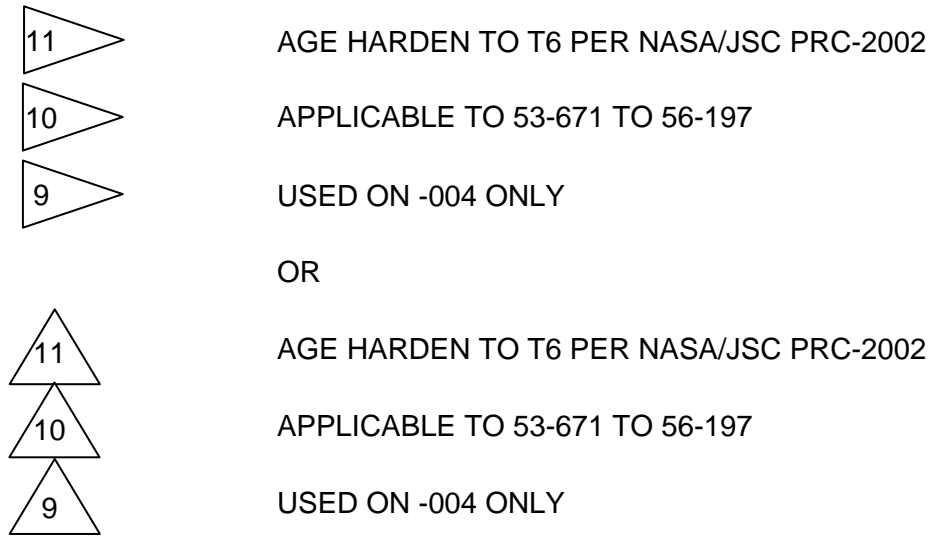
2.2.6.1 Types of Notes

2.2.6.1.1 Local Notes

Local notes, which appear on the field of the drawing, apply to specific operations or instructions and are placed adjacent to the point where the operations are required. Connect the callout to the point where the operations are required by a leader taken from either end of the top line of the note. Minimize the use of local notes to prevent congestion in the drawing field.

2.2.6.1.2 General Notes

General notes apply to the drawing as a whole. Number them consecutively, beginning with number one. Precede them with the statement: "NOTES: UNLESS OTHERWISE SPECIFIED." General notes shall not require reference or callout elsewhere on the drawing. General notes shall be located in the lower left corner of the drawing and in ascending order.

Figure 2.2-3. Specification of Flag Notes**2.2.6.1.3 Flag Notes**

Place flag note symbols around note numbers that are shown in the field of the drawing. Flag notes may be numbered separately from general notes or the flag symbols may be included in the general notes. In either case the notes shall be numbered consecutively. The coding symbol consists of the note number, approximately one-eighth-inch high, placed in the center of a triangle that is proportional to text height. Place the symbol to the left of the first line of the note. The apex of the triangle shall point either up or to the right, but shall remain consistent throughout the drawing (Refer to Figure 2.2-3.). Also place the symbol at each location on the drawing to which the note applies. If flag notes are separate from general notes, place them to the right of or above the general notes in ascending order, and precede them by "FLAG NOTES."

2.2.6.2 Special Cases of Local Notes, General Notes, and Flag Notes**2.2.6.2.1 Special Instructions**

Originating organizations may delineate, on the face of the drawing, functional test requirements; procedures for adjustment, servicing, or repair; instructions for special assembly, installation, or modification; and other types of instructions or procedures. The originating organization shall place a descriptive title above or beneath each set of instructions as appropriate to clearly distinguish it from all other notes or instructions. The notes or instructions may appear on the field of the drawing as required.

2.2.6.2.2 Mandatory Inspection Points

A Mandatory Inspection Point (MIP) is a dimension, feature, process, or other aspect of a part or assembly that requires QA inspection or verification.

The MIP symbol (shown below) shall be placed on the drawing using the standard text size based on the drawing size (Refer to **2.1.2**).

MIP

The design organization shall place the MIP symbol in the vicinity of the dimension, feature or process to be inspected or verified, so long as there is no ambiguity as to which item is being MIP'ed.

To maintain consistency in the inspection process for the part or assembly, the design organization shall place the MIP on the original CAD drawing as opposed to placing the MIP on quality copies, as built records, etc.

The inclusion of a MIP on a drawing means that the dimension, feature or process which is MIP'ed SHALL BE inspected or verified by QAR. It does not, in any way, prohibit QAR verification of any other dimension, feature, or process called out on the drawing. Likewise, the absence of a MIP from a drawing does not prohibit QAR verification of any dimension, feature, or process called out on the drawing, nor does it imply that the part or assembly should not be verified as a normal course of the QAR verification processes.

2.2.6.2.2.1 MIP Usage

MIPs applied to dimensions means those dimensions a QAR shall verify according to the drawing.

MIPs applied to features, such as surface finish, geometric tolerances, or grain direction, means a QAR shall verify those features according to the drawing.

MIPs applied to processes, such as PRCs, means a QAR shall verify process was completed correctly.

2.2.6.2.3 Suitability Notes

Section deleted in Revision K.

2.2.6.2.4 Fracture Control Notes

If the part is identified as fracture critical per NASA-STD-5007 or other program-specific requirements, the drawing shall specify any required nondestructive evaluation (NDE) inspection or proof testing that is to be performed.

Note: Fracture criticality is designated on the parts list. Reference Sections 2.2.4.2 Parts Lists Entry Requirements, 2.2.4.3 Integral Parts List Columns, and 2.2.4.4 Additional Requirements for Separate Parts List.

2.2.6.2.5 Property Tag Notes

If the hardware depicted on the drawing is subject to application of a property tag per NPR 4200.1 and if location of the tag may affect functionality, the following flag note may be included: THIS AREA RESERVED FOR NASA PROPERTY TAG.

2.2.6.2.6 Serialization or Lot Numbering Notes

If the hardware depicted on the drawing requires traceability through serialization or lot numbers, a flag note shall be added which provides detailed part marking instructions per NASA/JSC PRC-9002. If the part is too small to legibly mark the serial or lot number, a general note shall be used instead of a flag note which indicates identification instructions.

Refer to the following formats:

- a. Items which can be marked or tagged at same drawing level.

On detail parts, and assemblies which can be marked or tagged at the same point in the manufacturing process as the drawing level itself, show the part number and serial number as text or a defined zone in the appropriate view and location on the face of the part. Point to the text or zone with a flag and leader. The corresponding flag note shall provide complete instructions. The following example is for clarification only:

{Flag x} PART NUMBER AND SERIAL NUMBER SHALL BE MARKED BY {xxx method} PER NASA/JSC PRC-9002. LOCATE APPROXIMATELY AS SHOWN. SERIAL NUMBER SHALL BE ASSIGNED BY NASA/JSC EDCC PER JPR 8500.4.

For parts which must be tagged, a general note shall provide complete instructions. The following example is for clarification only:

BAG AND TAG TO IDENTIFY PART NUMBER AND SERIAL NUMBER PER NASA/JSC PRC-9002.

- b. Items which cannot be marked at same drawing level.

For assemblies which the marking method dictates that manufacturing perform the marking process at a lower drawing level (detailed part or subassembly) the following method is recommended:

On the lower drawing level, show the part number and serial number as text or a defined zone in the appropriate view and location on the face of the part. Point to the text or zone with a flag and leader. The corresponding flag note shall refer to the appropriate drawing level that defines the P/N and S/N and shall provide complete instructions for the marking. The following example is for clarification only:

{Flag x} SEE NEXT {OR TOP} ASSEMBLY FOR PART NUMBER AND SERIAL NUMBER MARKING INSTRUCTIONS. ENGRAVE CHARACTERS 3/16" HIGH PER NASA/JSC PRC-9002. LOCATE EXACTLY AS SHOWN. FILL IMPRESSIONS WITH CV-1144-1.

On the higher drawing level to which the part number and serial number pertain, again show the part number and serial number as text or a defined zone in the appropriate view and location on the face of the part. Point to the text or zone with a flag and leader. The corresponding flag note shall establish the part number and serial number marking instructions and refer to the appropriate drawing level on which the marking is performed. The following example is for clarification only:

{Flag x} ASSEMBLY PART NUMBER AND SERIAL NUMBER TO BE MARKED PER NASA/JSC PRC 9002 (SEE DETAIL DRAWING). SERIAL NUMBER SHALL BE ASSIGNED BY NASA/JSC EDCC PER JPR 8500.4 AND SHALL BE ASSIGNED AGAINST THIS DRAWING.

c. Multiple next assemblies

On detail parts which can be assembled into any one of several next assemblies, and on which a higher assembly P/N and S/N must be marked, use the method described in paragraph b above for the lower drawing level. Show as many placeholder X's in the P/N as necessary to accommodate all variations of next assembly number. On the higher drawing level to which the P/N and S/N pertain, use the method described in paragraph b above for the higher drawing level.

2.3 NUMBERING OF DRAWINGS AND PARTS

The JSC standard numbering system requires an 11-character (alphanumeric) drawing number, centrally controlled and issued by the EDCC only, as specified in Section 3.1.1. The part number consists of the drawing number plus a 3-digit dash number (See Figure 2.3-1). When identification of parts is required, specify on the drawing the desired method of marking and identification of parts. Refer to NASA/JSC PRC-9002.

Figure 2.3-1. JSC Drawing and Part Number Format

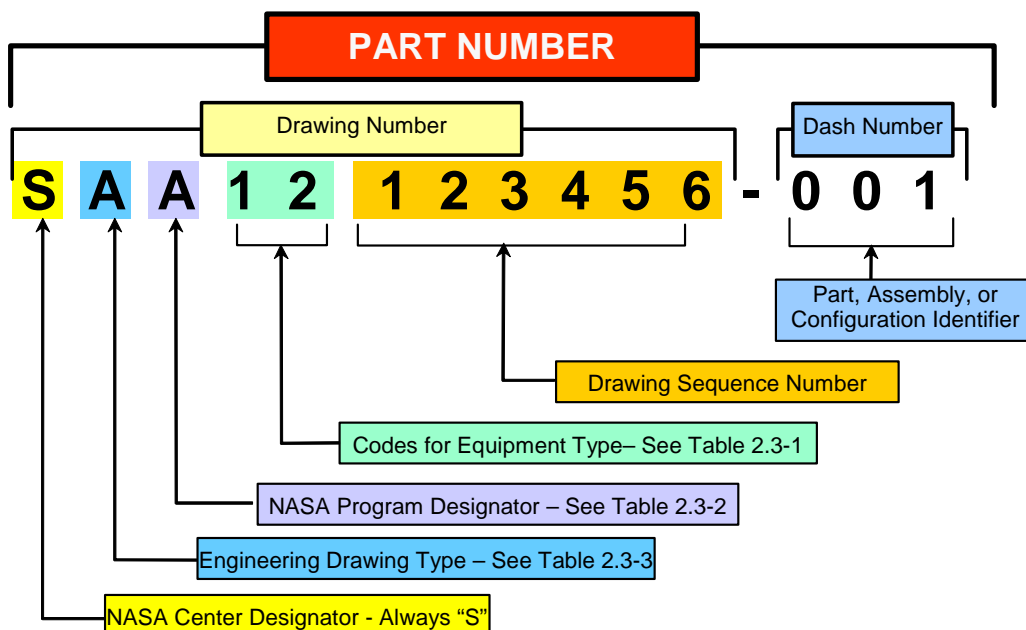


Table 2.3-1. Codes for Equipment Type

11	Environmental System	31	Planetary Landing
12	Crew Personnel Equipment	32	Crew Station
13	Space Suits	33	Crew Operation Equipment
14	Waste System	34	Recovery Support Equipment
15	Development Flight Instrumentation/Comm.	35	(Inactive)
16	Operational Instrumentation/Communication	36	Developmental, Experimental Eq. and Test Facilities (Nonflight)
17	Field Testing Instrumentation	37	Spacecraft Models (Wind Tunnel/Free Flight)
18	Scientific Instrumentation Communication	38	Ground Support Equipment
19	Stabilization and Control System	39	Experimental Equipment (Flight)
20	Guidance and Navigation Control System	40	Survival Equipment
21	Abort Guidance System	41	Operating Logic Schematics
22	Solid Propellant Motors	42	Bio-instrumentation
23	Liquid Propulsion Systems	43	Crew Trainers and Simulators
24	Reaction Control Systems	44	Concept Design Category
25	Power Generators	45	Spacecraft Operational Profile Drawing
26	Pyrotechnics	46	Life Sciences Experiments
27	Spacecraft Structures	47	Scanning Sensing Systems
28	Heat Protection	48	Food Systems
29	Mechanical Systems	50	Classified Drawings (of any equipment type)
30	Earth Landing	51	X-38 Crew Return Vehicle
		52	Bio-Medical Equipment

Table 2.3-2. NASA Program Designator

A	Gemini
B	Apollo
C	Skylab A and B (formerly Apollo Applications Program)
D	Space Shuttle
E	Earth Resources
F	Apollo-Soyuz Test Program
G	Space Station Program
H	Constellation Program
K	X-Crew Return Vehicle
M	Russian-Mir Program
N	New Initiatives or Advanced Programs

W	Institutional Programs (includes facilities)
Y	Developmental (non-program oriented)
Z	Multiprogram applications

For engineering drawing types and designations see Table 2.3-3.

Table 2.3-3. Engineering Drawing Type

A	Arrangement Drawing
B	Master Plan Drawing
C	Construction Drawing
D	Detail, Monodetail, Multidetail, Detailed Assembly, Match Parts, Tabulation Drawing
E	Assembly Drawing
F	Erection Drawing
G	Installation Drawing, Installation Control Drawing, Coordination Drawing, Correlation Drawing
H	Wiring Harness Drawing
I	Diagram, Elect, Electronic, Mechanical Schematic Wiring, Piping Drawing
J	Kit Drawing
K	Book – Form Drawing
L	Control, Source, Spec., Interface, Envelope Drawings

2.3.1 NASA Center Designation

The first element of the drawing number is the letter designating the NASA center. For drawings generated by JSC organizations and their contractors, use the letter “S” as the first letter of the drawing number.

2.3.2 Types of Engineering Drawings

The definitions provided below are guidelines taken from ASME Y14.24, but augmented with JSC customary practices and in some cases with clarifications and arbitrary definitions that attempt to minimize ambiguity in the use of the prefix second letter designations. Since second letter designation does not affect the way drawings are generated, reviewed or released and does not affect the way the hardware depicted thereon is implemented, these definitions are considered to be suggested usage only and are not mandatory. Originating organizations may adopt their own interpretation. However, the originating organization shall include one of the second letter designators defined in this section. Prefix second letter designation shall not be a cause for rejection or holding of drawings by technical discipline reviewers. Hardware processing shall not be delayed based on second letter designation.

2.3.2.1 Arrangement Drawing

Use “A” as second-letter designator. An arrangement drawing is an outline drawing that depicts in any projection or perspective, with or without controlling dimension, the relationship of major units of the item depicted (see ASME Y14.24).

2.3.2.2 Master Plan Drawing

Use “B” as second-letter designator. Not used for flight hardware or GSE drawings.

2.3.2.3 Construction Drawing

Use “C” as second-letter designator. Not used for flight hardware or GSE drawings.

2.3.2.4 Detail Drawing

Use “D” as second-letter designator. A detail drawing discloses complete fabrication requirements for the fabricated part(s) delineated thereon (see ASME Y14.24). This includes complete manufacturing details for fabricated parts and complete specification for commercial parts. Note that it is not necessary to define manufacturing details of commercial parts on a detail drawing; it is only required that sufficient information to define the design configuration of the commercial item be provided. Refer to Appendix B. Detail drawings are broken down into two classes: monodetail and multidetail.

2.3.2.4.1 Monodetail

This requires a separate drawing for each fabricated part.

- a. A standard monodetail drawing discloses complete fabrication requirements for a single fabricated part delineated thereon.
- b. A detailed part assembly includes complete fabrication requirements for a single fabricated part and installs simple commercial components that serve only to complete the function of some feature of the fabricated part—such as inserts or nut plates (with required attachment hardware) that provide threads to a machined hole. Assign the detailed part assembly, consisting of the fabricated part and its installed commercial parts, a dash number in the -301 series. Assign the fabricated detail part a dash number in the -001 series. Call out MIL spec parts by their MIL spec part number, call out commercial parts by their vendor part numbers, provide the vendor CAGE Code of the vendor's design organization in the parts list. Additional information such as vendor name and address may be provided as a flag note. (Also see Section 2.4 for guidelines on dash number assignment when rolling dash numbers.)
- c. Monodetail drawings may also be used as Altered Item Drawings. The design activity responsible for altering any standard or design or vendor activity item prepares an altered item drawing. When a vendor activity document is referenced, submit the vendor data along with the altered item drawing. If vendor or original design activity data are unobtainable, include in the altered item drawing the

necessary definition of the requirements for that item before its alteration. In an altered item drawing, show complete details of the changes and details necessary for identification of the item before alteration. Include the CAGE Code of the vendor's design organization. In a flag note, include the original part number. Additional information such as vendor name and address may be provided as a flag note. Include the notation "ALTERED ITEM DRAWING" in the title block after the title.

2.3.2.4.2 Multidetail

This depicts more than one fabricated part on a drawing.

- a. A detail-assembly drawing defines the assembled relationship and all the fabrication details of all the component parts of an assembly. This includes complete manufacturing details for fabricated parts and complete specification for commercial parts. If any other JSC drawings are called out on the drawing then it is not a true detail-assembly drawing, but rather is an ordinary assembly drawing instead and should have "E" as the second letter designator (see paragraph 2.3.2.5). Detail-assembly drawings are not allowed for flight hardware except for applications in which traceability of individual fabricated detail parts is not required, such as for soft goods drawings, or weldment drawings.
- b. A matched parts drawing depicts parts that are manufactured matched or otherwise mated, and for which replacement as a matched set is essential. An assembly dash number shall be assigned to the temporary matched set assembly depicted on the drawing in addition to the detail dash numbers that are assigned to the piece parts. Serial numbers shall also be assigned to the detail parts and to the matched set assembly for proper tracking of future replacements. Detail part numbers and serial numbers shall be permanently marked on the matched piece parts if possible. If the piece parts are too small to be marked or have a configuration that precludes marking (e.g., threaded parts) then they shall be tagged, bagged and tagged or otherwise container marked with part numbers and serial numbers. The matched set assembly part number and serial number do not have to be permanently marked on the hardware but may be shown on bag, tag or other container marking for proper tracking during manufacture. The matched set assembly part number shall be called out at the next assembly level rather than the detail part numbers. The next assembly hardware and all higher assemblies shall be serialized for proper tracking of matched set usage and replacement.
- c. A tabulated detail drawing depicts similar items, which as a group have some constant and some variable characteristics. A tabulated drawing precludes the preparation of an individual drawing for each item.
- d. Drawings depicting mirror image items are considered multidetail drawings.

2.3.2.5 Assembly Drawing

Use "E" as second-letter designator.

2.3.2.5.1 Relationship

An assembly drawing depicts the assembled relationship of (a) two or more parts, (b) a combination of parts and subordinate assemblies, or (c) a group of assemblies required to form an assembly of higher order. If any other JSC parts are called out on the assembly, use the letter “E” as the second-letter designator. If the drawing not only depicts the assembled relationship, but also defines all the details of all the component parts, then it is a detail-assembly drawing instead and should have “D” as the second letter designator. For example, an assembly with only commercial components should have “D” as the second-letter designator (see paragraph 2.3.2.4.2(a) above).

2.3.2.5.2 Assembly Type

Assembly drawings may be used to show both separable assemblies and inseparable assemblies. Separable and inseparable assemblies are described in Section 2.3.7.

2.3.2.5.3 Coating

Application of a finish process or coating/paint to a detail part does not constitute creation of an assembly. Use “D” as the second-letter designator.

2.3.2.5.4 Altered Item Assembly Drawings

Assembly drawings may also be used as Altered Item Drawings. The design activity responsible for altering any standard or design or vendor activity item prepares an altered item drawing. When a vendor activity document is referenced, submit the vendor data along with the altered item drawing. If vendor or original design activity data are unobtainable, include in the altered item drawing the necessary definition of the requirements for that item before its alteration. In an altered item drawing, show complete details of the changes and details necessary for identification of the item before alteration. Include the CAGE Code of the vendor’s design organization. In a flag note, include the original part number. Additional information such as vendor name and address may be provided as a flag note. Include the notation “ALTERED ITEM DRAWING” in the title block after the title.

2.3.2.6 Erection Drawing

Use “F” as second-letter designator. An erection drawing shows procedures and the operation sequence for erection or assembly of individual items or groups of items.

2.3.2.7 Installation Drawing

Use “G” as second-letter designator.

2.3.2.7.1 Installation Drawing

An installation drawing shows general configuration and complete interface installation information necessary to locate, position, mount, and attach an item relative to its supporting structure or to other items. An installation drawing may be used not only for

permanent installations, but also for temporary configurations for which it is desirable or necessary to document the configuration on an engineering drawing. These include but are not limited to the following installations and configurations:

- GSE hardware mounted to flight hardware
- “Remove Before Flight” items
- Test support equipment attached to flight hardware
- Shipping mounts and lifting attachments
- Special training configurations

2.3.2.7.2 Installation Control Drawing

An installation control drawing sets forth information for an item in terms of area and space, access clearances, training clearances, and similar data required to install and operate the item delineated. Installation control drawings are also known as “space control” or “working circle” drawings.

2.3.2.7.3 Coordination Drawing

A coordination drawing discloses a subsystem’s physical and functional interface engineering requirements which affect the design or operation of co-functioning subsystems. Coordination drawings are used as authoritative design control documents, delineating subsystem interface engineering data which have been coordinated for the purpose of (a) establishing and maintaining compatibility between co-functioning subsystems, (b) controlling interface designs, and/or (c) communicating design decisions and changes to participating activities. Coordination drawings are sometimes referred to as interface control drawings (ICDs) (see Section 2.3.2.9.11).

2.3.2.7.4 Correlation Drawing

A correlation drawing discloses the physical and functional interface engineering requirements between or among components within a subsystem. Correlation drawings are used to correlate interface engineering data between a subsystem design activity and its subcontractors and vendors involved in designing the subsystem.

2.3.2.8 Wiring Harness Drawing

Use “H” as second-letter designator. A wiring harness drawing shows the network of a group of wires laced together in a specific configuration to simplify installation.

2.3.2.9 Diagram Drawing

Use “I” as second-letter designator. .

2.3.2.9.1 Diagram Drawing

A diagram drawing delineates the features and relationships of items forming an assembly or system by means of symbols and lines. A diagram drawing is a graphic explanation of the manner in which an installation, assembly, or system (example: mechanical, electrical, electronic, hydraulic, pneumatic) performs its intended function.

2.3.2.9.2 Electrical and Electronic Diagrams

- a. A single-line or one-line diagram shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- b. A schematic or elementary diagram shows, by means of graphic symbols, the electrical connections and functions of a specific circuit arrangement. A schematic diagram facilitates tracing the circuit and its functions without regard to the actual physical size, shape, or location of the component devices or parts.
- c. A connection or wiring diagram shows the electrical connections of an installation or of its component devices or parts. It may cover internal or external connections, or both, and contains such detail as is needed to make or trace connections that are involved. A connection diagram usually shows general physical arrangement of the component devices or parts.
- d. An interconnection diagram is a form of connection or wiring diagram, which shows only external connections between unit assemblies or equipment.

2.3.2.9.3 Mechanical Schematic Diagram

A mechanical schematic diagram illustrates the operational sequence or arrangement of a mechanical device.

2.3.2.9.4 Piping Diagram

A piping (hydraulic, pneumatic, or fluid) diagram depicts the interconnection of components by piping, tubing, or hose, and when desired, the sequential flow of fluids in the system.

2.3.2.9.5 Drawing Tree

A drawing tree shows the hierarchical relationship of assembly, subassembly and component drawings, usually by means of diagrammatic symbols and lines. Since no hardware is depicted on the drawing tree itself, no discipline review is required – even if the drawings being diagrammed are flight hardware drawings. Drawing type category for Table 3.2-1 drawing approvals should therefore be “Non-flight Other” in all cases.

2.3.2.9.6 Kit Drawing

Use “J” as second-letter designator. A kit drawing indicates or depicts a packaged unit, item, or group of items, instructions, photographs, or drawings such as are used in

modification, installation, or survival. The items in a kit normally do not in themselves constitute a complete functional assembly. A kit drawing may be a listing of part numbers, a pictorial representation of parts, or a combination of both.

2.3.2.9.7 Book-Form Drawing

Use “K” as second-letter designator. A book-form drawing is a collection of several uniform-sized pages giving the engineering requirements of an item, a family of items, or a system. A book-form drawing is used for special-purpose applications such as adding technical data and instructions or applying software/firmware configurations, pertinent to related engineering drawings. Prepare book-form drawings exclusively on the templates provided through the EDCC. Book-form drawings shall only be used for special purpose drawings, not end product drawings. Examples of book-form drawings are:

- a. Engineering analysis data applicable to equipment or structural drawings
- b. Special procedures or instructions applicable to equipment such as that used for installation, operations, or testing
- c. Technical listings or tabulations pertinent to a drawing or group of drawings
- d. Software/firmware configurations applicable to equipment

2.3.2.9.8 Control Drawing

Use “L” as second-letter designator. Control drawings include source control drawings, specification control drawings, and ICDs.

2.3.2.9.9 Source Control Drawing

A source control drawing is used to limit the procurement of a vendor-designed and -manufactured part (or assembly) to that source and to depict interchangeable characteristics of the part selected and tested for a specific application. In the event the vendor will not provide drawings, the source control drawing shall include the same description of the part as required on specification control drawings. If vendor drawings are made available, the content of the source control drawing shall be limited to vendor’s part number, CAGE Code, name, and address. In either case, include the following note on the source control drawing: **“Only the part(s) specified on this drawing and identified by vendor’s CAGE Code(s), name(s), address(es), and part number(s) has (have) been tested and approved by JSC for use in (name of item).”** Do not use a substitute part without prior testing and approval by the responsible JSC activity. Although the source control drawing number is not a part number itself, it shall be entered (along with dash number if dash numbers are used on the control drawing) in the parts list of the next assembly drawing. The actual vendor part used will be identified by the vendor’s identifying number for procurement purposes and for as-built fabrication records.

2.3.2.9.10 Specification Control Drawing

A specification control drawing is used to record the characteristics of a vendor-designed and -manufactured part (or assembly), such as size, shape, mounting dimensions, performance, and other design requirements, including tests when applicable, that could be obtained from the vendor's manufacturing drawings if they were made available. The vendor's part number, CAGE Code, name, and address may be included as a suggested source but shall not be specified as the only source. This is because the purpose of a specification control drawing is to define design characteristics in enough detail that more than one vendor can build the item. Items provided by different vendors can then be interchangeable if they meet the specifications depicted on the drawing. Although the specification control drawing number is not a part number itself, it shall be entered (along with dash number if dash numbers are used on the control drawing) in the parts list of the next assembly drawing. The actual vendor part used will be identified by the vendor's identifying number for procurement purposes and for as-built fabrication records.

2.3.2.9.11 Interface Control Drawing

An ICD is the documented agreement between two parties which depicts physical and functional interface engineering requirements of a subsystem, which will affect the design, or operation of co-functioning subsystem(s) or equipment of two different systems. Such drawings are used as design control documents, delineating subsystem interface engineering data coordinated for the purpose of establishing and maintaining compatibility between functioning subsystems, controlling interface designs thereby preventing changes to subsystem requirements which would affect compatibility with functioning subsystems, and/or communicating design decisions and changes to participating activities.

Prepare ICDs in accordance with the applicable requirements of this manual. Delineate in the drawing, as necessary, configuration and all interface dimensional data applicable to the envelope, mounting, and mating of the subsystem; and complete interface engineering requirements, such as mechanical, electrical, physical, or functional characteristics which cannot be changed without affecting the system design criteria. Show the notation "INTERFACE CONTROL DRAWING" in the title block.

In addition to the usual required approval by an Approver, release of new or revised ICDs requires an Authorizer approval from an appropriate project representative. The Authorizer has the responsibility of ensuring that both parties to the interface have agreed to the information depicted on the ICD drawing. All changes to ICDs are to be made by drawing revision only. The use of DCNs on ICDs is not authorized (see Section 3.3).

2.3.2.9.12 Envelope Drawing

Use “M” as second-letter designator. An envelope drawing discloses the physical and functional engineering requirements for an item to the extent necessary to enable the development of the design details.

2.3.3 Program Letter

The third designator in the drawing number indicates the NASA program. This code designates the program for the initial use. It is not necessary to create new drawings to use the same equipment for different programs.

For instructions on obtaining a new program letter (see Section 3.1.1.)

The EDCC shall not use I, O, Q, or X as program letters (see Table 2.3-2).

2.3.4 Equipment Type

The fourth and fifth designators in the drawing number indicate the equipment type (see Table 2.3-1). For instructions on obtaining a new equipment type code, see Section 3.1.1.

2.3.4.1 Controlled equipment

2.3.4.1.1 Flight equipment

Most of the equipment type codes shown in Table 2.3-1 designate specific application or usage categories of flight hardware, software or firmware depicted on drawings. For applications of other flight equipment not specifically listed in the table, the originating organization shall use Code 39.

2.3.4.1.2 Ground Support Equipment

For Ground Support Equipment (GSE), the originating organization shall use Code 38 or, if applicable, Code 34 for Recovery Support Equipment.

2.3.4.1.3 Controlled models, trainers and simulators

For controlled models, trainers and simulators, the originating organization shall use Code 37 or 43 as applicable.

2.3.4.2 Uncontrolled equipment and non-equipment drawings

2.3.4.2.1 Uncontrolled equipment

For uncontrolled equipment, the originating organization shall use Code 36.

2.3.4.2.2 Non-equipment drawings

For operating logic schematics, concept design drawings and spacecraft operational profile drawings, the originating organization shall use Codes 41, 44 and 45 as applicable.

2.3.4.2.3 Exceptions

If an installation or assembly drawing depicts both flight and GSE components (for example, a chamber test drawing showing a flight space suit suspended from a GSE weight relief system) the originating organization shall use the GSE Code 38.

If an installation or assembly drawing depicts both flight components and uncontrolled equipment, (for example, a vibration lab drawing showing a flight heat shield tile bonded to an uncontrolled shaker table adapter plate) the originating organization shall use test equipment code 36.

If a project or discipline has been assigned a block of drawing numbers in a particular flight equipment code (for example, Bio-Medical Equipment with Code 52), that project or discipline can use numbers from that code for GSE and other non-flight items. This can be done because the drawing type designation in the title block (see Section 2.2.3, Table 3.2-1. Approval Required for Engineering Drawings) is used to determine the level of control of the hardware depicted on the drawing. However, the originating organization shall never combine a drawing type for one level of control with an equipment type for a lower level (for example, "Flight" with code 36 or "Aircraft Operations" with code 44).

2.3.5 Drawing Sequence Numbers

EDCC shall assign a set of individual drawing sequence numbers starting with 000001 to each equipment type listed in Table 2.3-1. The sequence numbers shall not be reserved for any one organizational activity but shall be assigned on an "as needed" basis.

2.3.6 Part-Numbering Format

The part number of all parts, assemblies, and installations detailed on JSC engineering drawings shall consist of the engineering drawing number, a dash, and three numerical digits as explained in Section 2.3.7 subject to the following requirements:

- a. Identify all unaltered items covered by an approved standard (such as military standards) by the appropriate standard number.
- b. Activities using items other than those of their own design without alteration shall identify such items by the original design activity part number, whether it is that of another government activity or a private vendor.
- c. Commercial or government standard items modified by JSC drawings to change physical or functional characteristics shall be assigned new JSC part numbers. Show

the words “MAKE FROM” or “M/F” followed by the original part number on the drawing face.

- d. Source control, specification control and envelope drawing numbers are not part numbers but shall be shown in the part number column of the parts list on the assembly or installation drawing when applicable. The part numbers of items qualified or approved for specific use by such control drawings shall be the original design activity part numbers.

2.3.7 Assignment of Dash Numbers

Dash numbers shall be used to identify configurations depicted on drawings:

2.3.7.1 Dash Number Categories

Dash numbers shall be assigned from the categories as defined below.

2.3.7.1.1 Numbers -001 to -099, -101 to -199, and -201 to -299

Numbers -001 to -099, -101 to -199, and -201 to -299 are reserved for individual components or detailed parts on detail drawings. These dash numbers may also be used for detail parts with applied coatings such as lubricant or paint. See example in Table B-7. Separate Parts List Example – Tabulated Detail Part Drawing with Bulk Item

2.3.7.1.2 Numbers -301 to -399

Numbers -301 to -399 shall be used to identify assemblies and subassemblies. These numbers are typically used for identifying separable assemblies and subassemblies. Separable assemblies are those which can be disassembled and reassembled multiple times without damaging any of the primary component parts. Examples include, but are not limited to, assemblies joined by threaded fasteners, rivets, snap rings, roll pins, quick release pins, and sewn items. NOTE: The distinctions between separable and inseparable assemblies are guidelines, not requirements. The originating organization may choose either series (numbers -301 to -399) or (numbers -701 to -799). Either selection shall be considered acceptable by technical discipline reviewers. Hardware processing shall not be delayed based on this selection.

2.3.7.1.3 Numbers -401 to -499

Numbers -401 to -499 are reserved for identification of installation drawings.

2.3.7.1.4 Numbers -501 to -599

Numbers -501 to -599 are reserved for identification of commercial items that have no manufacturer's part number. This series of dash numbers may be used on assembly drawings or to create a detail drawing specifying the part. For example, fasteners may be identified on assembly drawings using this series of dash numbers. The CAGE code for -50X series remains the same as the drawing CAGE code (e.g. If the drawing title block has 21356 as the CAGE code, the -50X part will have 21356 as the CAGE code in the parts list. Do not use the CAGE code of the manufacturer, standards organization, supplier, etc. This information or other information about the recommended source may

be specified in a flag note. Do not use this series for altered vendor items. Instead, use the -801 series (see below).

2.3.7.1.5 Numbers -601 to -699

Numbers -601 to -699 are available for originating organizations to use at their discretion to cover any unique circumstances or needs in that organization.

2.3.7.1.6 Numbers -701 to -799

Numbers -701 to -799 shall be used to identify assemblies and subassemblies. These numbers are typically used to identify inseparable assemblies or subassemblies for which the individual parts do not exist as separately identifiable end items upon completion of the assembly, or those assemblies so designed that disassembly is not possible without destroying the primary parts. Examples include, but are not limited to weldments, composite laminates, composite sandwiches, and bonded assemblies. NOTE: The distinctions between separable and inseparable assemblies are guidelines, not requirements. The originating organization may choose either series (numbers -301 to -399) or (numbers -701 to -799). Either selection shall be considered acceptable by technical discipline reviewers. Hardware processing shall not be delayed based on this selection.

2.3.7.1.7 Numbers -801 to -899

Numbers -801 to -899 are reserved but not required for identification of altered item parts. Both altered assemblies and altered single-piece parts may use this series. The CAGE code for -80X series remains the same as the drawing CAGE code (e.g. If the drawing title block has 21356 as the CAGE code, the -80X part will have 21356 as the CAGE code in the parts list.) Do not use the CAGE code of the vendor, manufacturer, standards organization, supplier, etc. This information or other information about the recommended source may be specified in a flag note.

2.3.7.1.8 Numbers -901 to -999

Numbers -901 to -999: Same as -601 to -699.

2.3.7.2 Sequential Assignment

Assign numbers sequentially using both odd and even numbers (e.g., -001, -002, -003, -004, etc.).

2.3.7.3 Symmetrically Opposite Parts

When symmetrically opposite (mirror image) parts or assemblies are defined on a drawing, use even and odd dash numbers where the even numbers are mirror images of the preceding odd numbers. If only one of two symmetrically opposite parts or assemblies is actually shown on the drawing, show the odd dash number and indicate the relationship with a note or label such as “-001 SHOWN, -002 OPPOSITE”. If mirror image parts or assemblies are shown, indicate this relationship with a note or label (e.g., “-002 OPPOSITE TO -001”). If the symmetrically opposite part or assembly has one or more features, components, or dimensions that vary from the basic part or

assembly, designate this in the view label (e.g., “-302 OPPOSITE TO -301 EXCEPT AS NOTED”) and then callout the specific difference(s) in the view.

2.3.7.4 Adding (Rolling) Dash Numbers

See Section 2.4.1.

2.3.7.5 Superseding Dash Numbers

- A dash number is superseded (i.e. replaced) by a new dash number when a new part configuration is created such that parts built to the new configuration will be used in place of parts built to the previous configuration.
 - In some cases, this replacement may apply only to future applications of the part.
 - In other cases, existing applications may be retrofitted with the new part configuration.
- Refer to EA-WI-027 or the Systems Engineering Office from the Engineering Directorate for clarification of issues dealing with hardware defined by superseded dash numbers

2.3.7.5.1 Dash Numbers Superseded

In all cases, when a dash number has been superseded, a statement shall be added to the Description of Change block that the old dash number is superseded by the new dash number. The old dash number may be left in the parts list or deleted. If deleted, previous versions of the drawing archived in the EDCC database will serve to document the old configuration for historical purposes.

2.3.7.5.1.1 Dash Numbers Deleted

If the dash number is deleted from the parts list then that configuration shall be removed from all views.

2.3.7.5.1.2 References to Deleted Dash Numbers

All references to the deleted dash number or its item/find number shall be removed from notes and callouts.

2.3.7.5.2 Superseded Dash Numbers

All superseded dash numbers shall be listed in a superseded/cancelled dash number table on the face of the drawing. See Table 2.3-4 for required contents of the table.

NOTE: If a new dash number is added that does not supersede any existing dash numbers, the table is not required to be updated or added.

2.3.7.5.2.1 Table to Remain

The table shall remain on all future revisions of the drawing.

2.3.7.5.2.2 Dash Number Superseded Shall Not Be Reused on Drawing

When a dash number has been superseded, it shall not be reused on the drawing to depict a new configuration.”

Table 2.3-4. Superseded and Cancelled Table

REV OLD DASH NO. REMOVED	SUPERSEDED	CANCELLED	NEW DASH NO.
A	N/A	-001	N/A
A	-002	-002	-004
N/A	-003	N/A	-005

2.3.7.6 Cancelled Dash Numbers

A dash number is cancelled when there is no acceptable use for that configuration. Refer to EA-WI-027 or the Systems Engineering Office from the Engineering Directorate for clarification of issues dealing with hardware defined by cancelled dash numbers.

2.3.7.6.1 Cancelled Dash Numbers

When a dash number is cancelled, a statement shall be added to the revision history block that the old dash number is cancelled. The old dash number may be left in the parts list or deleted. If deleted, previous versions of the drawing archived in the EDCC database will serve to document the old configuration for historical purposes.

2.3.7.6.1.1 Deleted Dash Numbers in Views

If the dash number is deleted from the parts list then that configuration shall be removed from all views.

2.3.7.6.1.2 Deleted Dash Numbers in Notes and Callouts

All references to the deleted dash number or its item/find number shall be removed from notes and callouts.

2.3.7.6.2 Superseded/Cancelled Dash Number Table

All cancelled dash numbers shall be listed in a superseded/cancelled dash number table on the face of the drawing. See Table 2.3-4 for required contents of the table.

2.3.7.6.2.1 Revised Drawing with Superseded/Cancelled Dash Number Table

The table shall remain on all future revisions of the drawing.

2.4 Configuration Control of Part Numbers

When a dash number has been cancelled, it shall not be reused on the drawing to depict a new configuration.

2.4.1 Changes Requiring New Part Identification

- a. Configuration management requirements for GFE engineering projects are governed by EA-WI-027. EA-WI-027 outlines changes to drawings that require assignment of a new identifying dash number for a part or assembly.

3 DRAWING CONTROL SYSTEM

The objective of the engineering drawing control system is to ensure drawing configuration control throughout the life of the drawing. All official JSC drawing review and approval is performed electronically using the JSC EDRS (EDRS Internet: <http://edcc.jsc.nasa.gov/>).

3.1 NUMBERING JSC DRAWINGS AND PARTS

The purpose of numbers on JSC drawings and parts is to provide a unique identifier during further processing. The EDCC controls drawing, lot, and serial numbers to avoid duplication and to ensure a standard numbering format.

3.1.1 Drawing Number Assignment

The EDCC assigns drawing numbers using the numbering system as defined in Section 2.3. Anyone with an active EDRS account can request drawing numbers. The EDCC records all assigned drawing numbers in the JSC Engineering Drawing System database, and will normally assign drawing numbers in sequence.

The EDCC should be involved as early as possible in situations where the need for exceptions in drawing numbering is identified, or when new program or equipment designators are required. In certain cases, a revision of the drawing control manual may be necessary.

3.1.2 Lot and Serial Number Assignment

JSC Policy Directive JPD 8500.3 governs serial/lot number assignments for all GFE engineering projects.

3.1.2.1 Trace Code

Serialization and lot numbering requirements for parts shall be established by entering the appropriate code in a column labeled "TRACE CODE" on the parts list.

For fabricated parts that have a JSC part number these requirements shall be established on the drawing that defines the part. On assembly drawings that call out fabricated parts with JSC part numbers that were defined on lower level drawings the appropriate trace code shall be repeated in the parts list as reference information only.

Serial and lot numbers for JSC numbered parts (reference Section 2.3) are assigned by EDCC. Refer to JPD 8500.3.

For commercial parts (those that have a vendor, mil spec, or industry standard part number) these requirements shall be established on the drawing that specifies the part. Serial and lot numbers for commercial parts are assigned by the vendor, not the EDCC. These numbers may be tracked in DDMS.

Serialization and lot numbering requirements for commercial parts may be established on JSC drawings without regard to the common practice for producing those parts; for example, NAS fasteners used on uncontrolled equipment may be called out as exempt from serialization and lot numbering requirements even though such fasteners are normally sold by lots.

The codes used shall be:

- TS - the part shall have a serial number
- TL - the part shall have a lot number
(date codes may be substituted for lot numbers on vendor items)
- TM - the part shall have both a serial number and lot number
- TE – the part is not required to have either serial number or lot number

If parts have special traceability requirements such as chemical analysis or date codes, the design organization shall designate the part as TS, TL or TM and shall include a special flag note or general note outlining requirements beyond serial or lot numbers.

3.1.2.2 Serial Number Requirements

Serial numbers for JSC numbered drawings and non-JSC numbered drawings for which JSC is the design authority shall:

- a. be assigned sequentially based on the drawing number of the hardware, not on dash numbers.
 - o JSC Numbers shall be tracked in the EDCC
 - o Non-JSC numbers shall be tracked in the DDMS
- b. not be duplicated against an individual drawing number (unless lot numbering is in effect—see Section 3.1.2.3 below, Figure 3.1-3).
- c. begin with 1001 on the first production run unless special circumstances warrant starting at 0001. Contact the EDCC supervisor for approval of special circumstances. In general, the special circumstances are limited to items with legacy serial numbers and production runs larger than 8999 serialized items. Subsequent production runs shall follow serially unless lot numbering is in effect. In that case, serialization will start over at 1001 (except for the special circumstances starting at 0001) for each production run and this procedure shall be used regardless of what manufacturer produces the run (see below).

- d. If previous serial numbers on items to be re-fabricated are unknown or are questionable, resumption of serial number assignment will begin with 4001 to prevent serial number duplication (see Figure 3.1-1).

Figure 3.1-1. Serial Number Assignment

DWG NUMBER	DASH NUMBER	SERIAL NUMBER
SDG39129587	-001	1001
		1002
		1003
SDG39129587	-002	1004
		1005
		1006
SDG39129587	-003	1007
		1008
		1009

3.1.2.3 Lot Number Requirements

Lot numbers for JSC numbered drawings and non-JSC numbered drawings for which JSC is the design authority shall:

- a. Be assigned sequentially based on the drawing number of the hardware, not on dash numbers. Users may request special sequences from the EDCC and these requests shall be granted providing the desired lot numbers have not previously been assigned.
 - 1) JSC Numbers shall be tracked in the EDCC
 - 2) Non-JSC numbers shall be tracked in the DDMS
- b. Not be duplicated against an individual drawing number.
- c. Be a three letter alpha designator. The designing organization may use these characters arbitrarily or for specific tracking purposes. The letters I, O, Q, and Z shall not be used (see Figure 3.1-2).

Figure 3.1-2. Lot Number Assignment

Part Number	Manufacturer	Production Run	Lot Number
SEG26123456-001	JSC	1	AAA
SEG26123456-001	JSC	2	AAB
SEG26123456-001	Company A	1	AAC
SEG26123456-001	Company A	2	AAD
SEG26123456-002	JSC	3	AAE
SEG26123456-002	Company A	3	AAF

Figure 3.1-3. Serialized Lot Number Assignment

Part Number	Manufacturer	Production Run	Lot Number	First Serial Number
SEG26123000-301	JSC	1	AAA	0001
SEG26123000-301	JSC	2	AAB	0001
SEG26123000-301	Company A	1	AAC	0001
SEG26123000-301	Company A	2	AAD	0001
SEG26123000-701	JSC	3	AAE	0001
SEG26123000-701	Company A	3	AAF	0001

3.1.2.4 Procedures for Serial/Lot Number Assignment

To obtain serial or lot numbers contact the EDCC, and furnish the following information:

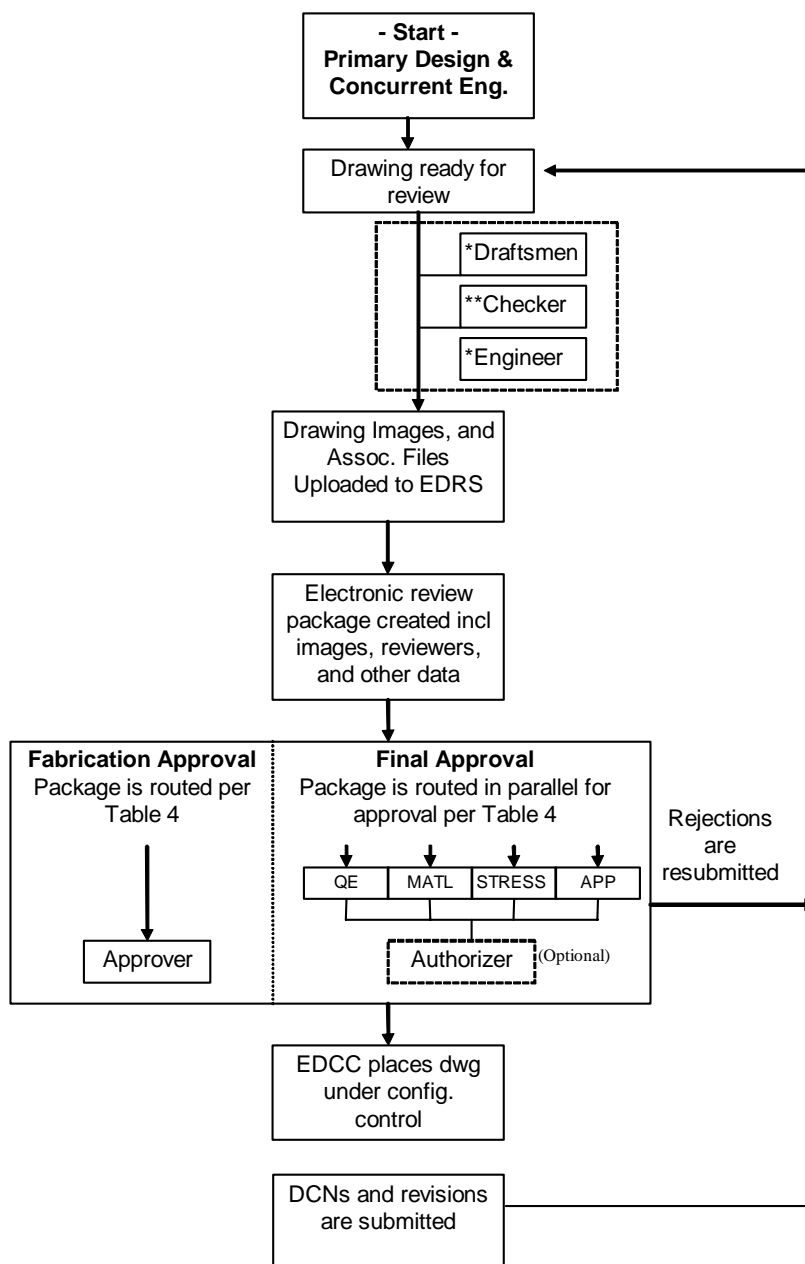
- Name and organization code
- The basic drawing number
- Quantity of serial and/or lot numbers needed
- Special circumstances (such as questionable prior serial number usage, lot number effect on serial numbers requested, etc.).

3.2 DRAWING REVIEW, APPROVAL, AND ARCHIVING

Drawing review implies an examination, inspection, or analysis of a drawing or features of a drawing, with the intent of verifying compliance with JSC design specifications

including this document. Drawing approval is the successful outcome of drawing review. JSC drawing approval is summarized in the flow chart shown in Figure 3.2-1.

Figure 3.2-1. JSC Drawing Approval Process



*Approval requirements internal to each division. Names manually entered by drafter.

**Checker may be entered manually by drafter or selected as reviewer on drawing package. If selected their approval becomes mandatory, although it is not called out in Table 4.

3.2.1 Engineering Drawing Review

The standard title block on engineering drawings provides blocks for the electronic entry of the names of drawing reviewers. Because of space limitations abbreviations are used to label the blocks.

The paragraphs below explain the meaning of each approval abbreviation, the functional identity, and the responsibilities of the person providing the approval.

NOTE: For JSC drawings, the names and dates in the title block indicate the person responsible for that specific revision of the drawing and the date that revision was submitted for review. For example, if one drafter generated the first release of the drawing, and another drafter changes anything on a later release, the new drafter's name and new date goes in the title block.

3.2.1.1 DR (Drafter)

Person who generated the drawing, or last revised it. The Drafter's name and date is manually added to the drawing before submitting it to the EDRS. Drafters are responsible for:

- a. providing adequate information on the drawing for the intended use of the drawing.
- b. presenting the drawing information in a sufficiently clear and unambiguous manner so that technically competent users can understand all the drawing information.
- c. compliance with JSC standard engineering drawing format requirements.

3.2.1.2 ENG (Design Engineer)

Person who designed or last revised the item depicted on the drawing or who specified the item described on the drawing. The Design Engineer's name and date shall be entered on the drawing manually before submitting it to the EDRS. The Design Engineer is the one currently responsible for:

- a. generating a hardware (or firmware) configuration that is adequate technically and functionally for its intended purpose.
- b. verifying to the lowest level of detail that the configuration depicted is adequate, technically and functionally for its intended purpose.
- c. the accuracy of the items listed above under drafter's responsibilities.

3.2.1.3 CH (Checker)

Person who verifies specific aspects of the drawing determined by the originating organization. The Checker's name and date may be entered manually by the drafter, or selected as a reviewer when creating the EDRS drawing package. If selected in the EDRS the Checker approval becomes mandatory, even though it is not called out in Table 3.2-1. The Checker approval is optional, and if not used, the Checker block shall be left blank. Checker responsibilities typically might include one or more of the following:

- a. verifying compliance with JSC standard engineering drawing format requirements
- b. verifying all aspects of the drawing listed above under draftsman's responsibilities
- c. verifying all aspects of the drawing listed above under design engineer's responsibilities

3.2.1.4 APP (Approver)

Appropriate (technically cognizant) subsystem manager or project lead within the originating organization (Office of Primary Responsibility, or OPR). Responsible for:

- a. verifying that the hardware configuration depicted or described on the drawing is adequate to meet the program, project, or mission requirements,
- b. verifying that information in the drawing title block is accurate and correct.
- c. determining if any of the optional approvals in Table 3.2-1 should be required. For example, a mockup with hazardous potential may require stress and QE.

This approval, which the EDRS adds electronically, is mandatory on all released drawings.

3.2.1.5 QE (Quality Engineering)

Quality Engineering representative officially designated by the SR&QA Flight Equipment Division. To receive authorization to approve drawings as QE, contact the NT Branch Chief for Institutional Quality. When selected, this approval is added electronically by the EDRS. Quality Engineers are responsible for verifying that:

- a. the item depicted on the drawing can be produced.
- b. the item depicted is verifiable.
- c. quality assurance requirements are specified if required, and are adequate to meet the program, project, or mission requirements.

3.2.1.6 MATL (Materials & Processes)

Materials and Processes representative officially designated by the Structural Engineering Division. To receive authorization to approve drawings for materials, contact the Materials and Processes Branch Chief in this division. When selected, the EDRS adds this approval electronically. These representatives verify:

- a. that materials and processes called out on the drawing are acceptable in the quantities shown for the relevant hardware type and application.
- b. that fracture criticality of the part(s) or assembly(s) has been defined.

3.2.1.7 STRESS

Stress representative whose qualifications have been approved by the Structural Engineering Division. Responsible for verifying that the item depicted on the drawing is structurally adequate for the defined design environment. The stress approval

designates that there has been a review of the original design environments and that the appropriate strength calculations have been performed. This is not to be construed as either a functional endorsement of the item or a certification of flight readiness, and only ensures adequate safety margin for structural capability. To receive authorization to approve drawings for stress, contact the Structural Engineering Division Chief. When selected, the EDRS adds this approval electronically.

3.2.1.8 AUTH (Authorizer)

Authorizer designated by the OPR. This approval is optional and may be used by the submitting organization in accordance with internal work instructions. On an ICD, the Authorizer is responsible for ensuring that both parties to the interface have agreed to the information depicted on the ICD drawing (see also 2.3.2.9.8). If used, the drawing package shall not be released until the Authorizer accepts it. When selected, the EDRS adds this approval electronically.

3.2.2 Approval Requirements on Engineering Drawings

Drawings produced in accordance with JPR 8500.4 shall be reviewed and approved by certain designated reviewers. The different types of hardware produced by and for JSC, as well as the different control stages, require different sets of approvals (see Appendix C for definitions of hardware drawing types). Table 3.2-1 defines the minimum approvals which are required for each situation. All other approvals not defined by this table are optional. NOTE: If materials certification of components on drawings is required the project shall establish a policy for additional approvals such as materials, stress, or QE. EDRS shall place the reviewer's name electronically on the drawing.

Table 3.2-1. Approval Required for Engineering Drawings

Control Stage	Drawing type	ENG (Engineer)	QE (Quality Eng)	MATL (Materials)	STRESS	APP (Approver)	AUTH (Authorizer)
Fabrication Approval	All drawing types	X				X	
Final Approval	Flight/GSE Elect Software	X	X			X	
	Flight/GSE Firmware	X	X			X	
	Flight/GSE Schematics	X	X			X	
	Flight/GSE Decals	X	X	X		X	
	Flight Crew Clothing	X	X	X		X	
	Flight Food & Containers	X	X	X		X	
	Flight Medical Supplies	X	X	X		X	
	Flight Portable COTS A/V Equip	X	X	X		X	
	Flight/GSE Electrical Cable	X	X	X		X	
	Flight ICD	X				X	X
	Flight CCCD/SSCCD					X	
	Flight	X	X	X	X	X	
	Aircraft Operations	X	X	X	X	X	
	GSE	X	X	X	X	X	
	Crew Trainer	X				X	
	Developmental	X				X	
	Engineering Unit	X				X	
	Mockup NBL	X				X	
	Mockup-SVMF	X				X	
	Mockup-Other	X				X	
	Non-flight Software	X				X	
	Non-flight Firmware	X				X	
	Non-flight Schematic	X				X	
	Non-flight Other	X				X	
	Prototype	X				X	
	Test Support Equipment	X				X	
	DCN to Change OPR	X				X	X*

*This change requires an authorizer from the OPR of record. EDCC shall accept a written notification from a division-level authority in the OPR of record in lieu of a DCN to change the OPR. Reference section 3.3.2.

An organization that originates engineering drawings may request alternate approval authority from that specified in Table 3.2-1 for a specific project or activity. Such requests shall be prepared for the approval of the Engineering Drawing System OPR (Director, Engineering) and the concurrence of the Director of Safety and Mission Assurance.

3.2.3 Approval Verification

The appropriate approval authority shall sign a completed JSC Form 1237, which all organizations involved in approval of engineering drawings shall submit to the EDCC. This form identifies those individuals who are officially designated by the originating

organization as APPROVERS and/or AUTHORIZERS for the identified OPR code in accordance with Table 3.2-1.

The EDCC shall maintain an on-line database of officially designated QE, materials & processes, stress reviewers, approvers, and drawing authorizers. Use this central database as the source for approved drawing reviewers.

Before releasing each drawing, the EDRS shall verify that it has been accepted by all of the mandatory reviewers selected by the submitter. If the drawing is not accepted within 30 days, the EDRS shall send notification to the submitter.

3.2.4 Fabrication Approval of Drawings

Drawings may be approved for fabrication before final approval. It is not a requirement to release drawings for fabrication approval before final approval. Drawings can start at the final approval level. However, once a drawing has been released at the final approval level, the fabrication approval procedures cannot be used for subsequent revisions. Fabrication approved drawings shall be reviewed as indicated in Table 3.2-1. In addition to the responsibilities specified in Section 3.2.1.2, fabrication approval indicates that the person approving the drawing, as designated in Table 3.2-1 has assumed responsibility for all other reviewers described in Section 3.2.1. This responsibility is intended to be temporary and reverts back to the appropriate review disciplines upon final approval of the drawing. However, it is good practice to obtain other discipline approvals as needed. For example, one approach is to obtain Stress and/or Materials approvals for the first fabrication approval release. The submitter would then have the option on the next fabrication revision to continue getting these or other approvals or bypass them as appropriate.

Fabrication approved drawings shall be updated to incorporate all changes as specified in Section 3.3.1. Drawings shall receive final approval before the responsible quality assurance organization gives final acceptance of hardware.

Submission of a fabrication approved drawing into the EDCC indicates that:

- a. A drawing has passed engineering review and approval.
- b. The drawing image and related drawing data have been electronically recorded.
- c. The EDCC assumes primary responsibility for the official current configuration of the drawing including all outstanding changes and has authority to issue the current version and its changes.
- d. Changes made to a fabrication approved drawing after its release into the EDCC shall be performed in accordance with requirements specified in Section 3.3.
- e. Versions of fabrication approved drawings shall be identified, tracked, and controlled by means of revision numbers. The first version approved shall be designated with a number "1." Subsequent revised versions shall be designated sequentially with "2," "3," "4," etc. (For all electronic drawing formats except MS Word, the EDRS, rather than the drawing originator, shall add these numbers to the drawing image automatically.)

3.2.5 Final Approval of Drawings

Final Approval indicates that:

- a. A drawing has passed final review and approval.
- b. The drawing image and related drawing data have been electronically recorded.
- c. The drawing is under configuration control by the EDCC.
- d. The EDCC is now the organization having primary responsibility for the official current version and for the historical archive of past versions of the drawing and is the issuing authority for these versions.
- e. Any changes to the drawing after it is accepted by the EDCC shall be made in accordance with requirements specified in Section 3.3.
- f. Versions of final approved drawings shall be identified, tracked and controlled by means of revision letters. The first version approved shall be designated with the letters "NC" (for "no change"). The first **revised** version shall be designated with the letter "A." Subsequent revised versions shall be designated sequentially with the letters "B," "C," "D," etc. Do NOT use the letters I, O, Q, S, X, Z as revision letters because they are easily misread as numbers (either Arabic or Roman numerals). When revisions are numerous enough to exhaust the alphabet, the revision following "Y" shall be "AA," the next shall be "AB," "AC," etc. Should "AA" to "AY" be exhausted, the next sequence shall be "BA," "BB," etc. (The EDRS, rather than the drawing originator shall add these letters to the drawing image automatically.)

3.2.6 Validation

The EDCC reviews drawings submitted to the EDRS for the information shown below. If incomplete or invalid, the EDRS shall notify the package originator that the drawing has been held for comments.

- a. Verify consistency of drawing number on drawing image, EDCC drawing record, and EDRS drawing package.
- b. Drawing revision letter or number is not typed manually in the title block, and is identified correctly in the drawing revision description block on the drawing image and in the database. Note: The EDRS inserts this revision number automatically.
- c. Next Assembly information is entered as per Block P.
- d. DCN incorporation (if applicable) has been called out in revision description block.
- e. Page entries on drawing match physical page count.
- f. Drawing revision letter matches the revision letter referenced on separate parts lists.
- g. Hardware type and approvals match as per Table 3.2-1.
- h. Ensure fracture criticality has been addressed on relevant drawings in accordance with Sections 2.2.6.2.4 and 2.2.4 of this document.
- i. Title on drawing image matches the EDCC database record.

- j. Ensure that all applicable changes are noted in the revision history block, as described in Section 3.3.1.
- k. Errors on the drawing that would prevent entry of the part or drawing into the Design and Data Management System, DDMS (e.g. incorrect part numbers, missing parts list data). .

3.2.7 Archiving

Archive drawing information in the EDCC drawing database and also archive all drawing images per Title 36 of the Code of Federal Regulations, Chapter XII, Part 1234.

The EDCC controls all approved drawings. Final Approval drawings receive a “FINAL APP” stamp and date, and Fabrication Approval drawings receive a “FAB APP” stamp and date. The following information is stored in the EDCC database. Items marked with an asterisk (*) are not mandatory for fabrication approved drawings. Drawing information on the drawing image, as entered by the drafter, shall be identical to the information in the EDCC database .

- a. Drawing number
- b. Drawing size
- c. Drawing title
- d. Date
- e. Organization code
- f. Next assembly drawing number, if applicable; N/A if not applicable *
- g. Revision letter (or number for fabrication approval drawings)
- h. Drawing page count

3.2.8 Distribution

Individuals on the drawing distribution list shall be notified by electronic mail that the drawing image may be accessed from the electronic drawing database. Electronic drawings shall be maintained in the EDCC drawing database and shall be accessible through the EDCC web site. Paper copies may be printed locally or requested through the EDCC web site.

3.3 DRAWING REVISIONS AND CHANGE NOTICES

Changes to JSC engineering drawings are initiated using one of the following methods:

- a. Drawing revision
- b. DCN
- c. Redline changes

Interface control drawings can only be changed by drawing revision, and require the approval of the appropriate design-change authority before submission. It is the design

activity's responsibility to ensure that changes and revisions to flight equipment and GSE do not violate interface control agreements, and that applicable ICDs are revised when required as a result of equipment configuration changes.

Additional limitations along with procedural guidelines are in the following sections.

3.3.1 Revision of Drawings

To effect drawing revisions, submit a modified drawing that incorporates the changes. **The EDRS enters the revision code in the revision box in the title block.** The drawing originator enters the revision code in the REV column of the revision history block at the upper right corner of the drawing. The revision history block is the table that includes the columns: Rev, Zone, and Description of Change as shown in Figure 3.3-1.. Indicate revisions for Fabrication Approval drawings using sequential numbers. Indicate revisions for Final Approval drawings using sequential letters.

Initiate a drawing revision by generating a new drawing, which incorporates the proposed changes, to also be noted in the revision history block.

Revised drawings require review and approval as designated in Table 3.2-1 based on the type of hardware and drawing control stage (see Section 3.2.2). Fill out revision history block as shown in Figure 3.3-1. Itemize incorporated DCNs in the revision history block, as shown in Figure 3.3-1. All DCNs applicable to a particular revision shall be accounted for in the revision history block, either by incorporation or cancellation note.

It is not required to maintain all revision history of previous revisions with each subsequent revision. For details, reference ASME Y14.35M.

Figure 3.3-1. Revision History Block

REV	ZONE	DESCRIPTION OF CHANGE
A*	E9	1. MATERIAL WAS QQ-S-633 FOR -001 PART 2. INCORPORATED DCN SED39104621NC01

OR

REV	ZONE	DESCRIPTION OF CHANGE
B*	C12	1. INCORPORATED DCN SED39104621A01

*Sequential numbers shall be used for FAB APP drawings

Record the drawing change record on the first sheet of multisheet drawings. A revision history block is not required on subsequent sheets of multisheet drawings. Note that the EDRS shall insert the revision letter or number automatically into the title block on every sheet.

The following types of changes shall be noted in the revision history block:

- a. Changes to the title block including Drawing CAGE Code, title, prefix, next assembly number, drawing size, hardware type, or page count
- b. Changes that make an existing dash number cancelled and/or superseded
- c. Addition or deletion of dash numbers.
- d. Changes to existing items on the parts list including quantity, parts CAGE Code, part number, description, Trace Code, materials, specification blocks

The statement “Revised and Redrawn” may be entered into the revision history for those changes too numerous to list individually. This does not apply to the changes listed above; those shall always be listed individually in the revision history.

Changes to an organization code shall be submitted on a DCN or written notification prior to drawing revision using the new OPR (See Table 3.2-1 for approval requirements for OPR change).

For FINAL APP drawings, identify change indicators by the “revision letter” – “sequential change number.” Example: for revision B and change number three, the indicator would read B3.

For FAB APP drawings, identify change indicators by the “revision number” - “sequential change number.” Example: for revision 2 and change number three, the indicator would read 2-3.

There are several options for promoting drawings from Fabrication Approval to Final Approval.

- a. If there are no changes required, the drawing may be released to final approval level revision “NC”
 - 1) without including a row in the revision history block.
 - 2) including an entry in the revision history block with the text “FAB DRAWING RELEASED FOR FINAL APPROVAL” as shown in Figure 3.3-2.

Figure 3.3-2. FAB to FINAL Revision History Block with No Changes

REV	ZONE	DESCRIPTION OF CHANGE
NC		1. FAB DRAWING RELEASED FOR FINAL APPROVAL

- b. If there are changes required,
- 1) another fabrication revision can be released to incorporate and document changes. Then the drawing can be promoted to final approval using one of the methods discussed above.
 - 2) the drawing can be released to final approval level revision "NC" with the Revision history block filled out as shown in Figure 3.3-3.

Figure 3.3-3. FAB to FINAL Revision History Block with Changes

REV	ZONE	DESCRIPTION OF CHANGE
NC	C12	1. WAS R .030.

3.3.2 Drawing Change Notices

A DCN is an interim method of changing the information contained on an engineering drawing after the drawing has been approved. Such changes are to be incorporated into the drawing by formal revision unless otherwise specified on the DCN. DCNs require review and approval as designated in Table 3.2-1 based on the type of hardware and drawing control stage (see Section 3.2.2). The DCN shall remain active until incorporated by revision and so noted in the Revision history block. The design organization shall revise the drawing before the number of DCNs exceeds 5 unless prior approval is obtained. To request such approval, the design organization shall submit a written request to the EDCC supervisor.

To retain EDCC data integrity, a change to the OPR of a drawing requires a DCN be released before releasing the revised drawing. Alternatively, the OPR of record may send a memo requesting changing of the OPR. The EDCC record must be updated by the EDCC before the system will accept a revision to the drawing. Reference Table 3.2-1. If the OPR of record no longer exists, the next higher level authority for the OPR of record must provide a memo to EDCC establishing transfer of the OPR. (e.g. EM no longer exists, therefore EA must write the memo to transfer the OPR of record). Title, prefix, next assembly number, drawing size, and page count changes do not require DCNs, but they shall be called out in the revision description block of the affected drawing.

Account for DCNs with limited affectivity (affect only certain serial/part numbers of a drawing), but do not incorporate them in the drawing revision. Example: "DCN SDD39125277A01 not incorporated due to limited affectivity" would be written in the REV block of the drawing being revised. Affectivity shall be described in the lower portion of the DCN.

Submit DCNs electronically using the EDRS. Generate DCNs that include a sketch using the same CAD system as the original drawing, if possible. DCNs that include only text may be completed using the JSC standard word processor. MS Word templates are available from the EDCC web site.

The upper portion of the DCN form contains several blocks for entering data to identify the DCN itself and the drawing and hardware to which it pertains. Other blocks define the reason for the configuration change, the approver(s) for the change, and the date and page number. Fill out these blocks as follows (see Figure 3.3-4). Include in the lower portion of the DCN a description of the changes made to the drawing and the condition existing before the change. The description may be by sketch, written text, or combination thereof, and shall be self-explanatory without requirement for reference to other DCNs for the change description, although reference to other DCNs is permitted.

At the discretion of the drawing originator (and before the number of DCNs against a particular drawing is greater than 10), submit a drawing revision that incorporates all outstanding DCNs.

If the DCN is approved, each individual identified in the EDRS package distribution list will be notified by e-mail of a new DCN against the associated drawing.

Figure 3.3-4. DCN Info Format

DCN NUMBER			DRAWING CHANGE NOTICE				SHEET 1 OF	
DRAWING NO.	REV	SEQ#	FMT	ORIGINATOR	DATE	QE	DATE	
DRAWING TITLE			REASON FOR CHANGE	ENG		MATL		
PROJECT				CH		STRESS		
				APP		RELEASE STAMP		
				AUTH				

Callout letters: A points to 'SHEET 1 OF'; B points to 'DRAWING NO.'; C points to 'REV'; D points to 'SEQ#'; E points to 'DRAWING TITLE'; F points to 'PROJECT'; G points to 'REASON FOR CHANGE'; H points to 'AUTH'; I points to 'RELEASE STAMP'; J points to 'DCN NUMBER'; K points to 'DATE' (under ORIGINATOR).

- Block A indicates the total number of sheets.
- Block B is reserved for the drawing number of the drawing that is being changed. The submitter shall enter the drawing number.
- Block C specifies the current revision letter or number of the drawing being changed (not the revision that will incorporate the DCN in the future). **Note:** For all electronic drawing formats except MS Word leave this block empty. It shall be filled by the EDRS.
- Block D indicates the sequence number of the DCN, starting with 01. The EDRS creates this number.
- Block E is reserved for the title of the drawing that is being changed.

Block F	is reserved for the title of the hardware project										
Block G	is reserved for reason for change. Enter a brief, general statement noting why the change is being implemented. If applicable, reference the revision authorization document, such as a Change Control Board Directive number or Discrepancy Report number implementing the revision. Other descriptive terms for "reasons" that may be used are given below:										
	<table> <tr> <td>DESIGN ERROR</td><td>DESIGN IMPROVEMENT</td></tr> <tr> <td>FACILITATE PROCUREMENT</td><td>FACILITATE FABRICATION</td></tr> <tr> <td>DRAFTING ERROR</td><td>IMPROVE RELIABILITY</td></tr> <tr> <td>HARDWARE AVAILABILITY</td><td>CHANGE IN REQUIREMENTS</td></tr> <tr> <td>DRAWING OMISSION</td><td>IMPROVE FUNCTION</td></tr> </table>	DESIGN ERROR	DESIGN IMPROVEMENT	FACILITATE PROCUREMENT	FACILITATE FABRICATION	DRAFTING ERROR	IMPROVE RELIABILITY	HARDWARE AVAILABILITY	CHANGE IN REQUIREMENTS	DRAWING OMISSION	IMPROVE FUNCTION
DESIGN ERROR	DESIGN IMPROVEMENT										
FACILITATE PROCUREMENT	FACILITATE FABRICATION										
DRAFTING ERROR	IMPROVE RELIABILITY										
HARDWARE AVAILABILITY	CHANGE IN REQUIREMENTS										
DRAWING OMISSION	IMPROVE FUNCTION										
Block H	is reserved for approvals. The same requirements as those for initial drawing approval apply (see Section 3.2.2).										
Block I	is reserved for the EDCC Approval stamp. Do not mark in this block.										
Block J	indicates that the DCN number is comprised of the drawing number, revision letter, and sequence number (Note: Block C, and D are completed by the EDCC).										
Block K	is reserved for the date. Dates shall be entered as M/D/YY or MM/DD/YY (e.g., March 1, 2004 would be 3/1/04 or 03/01/04).										

3.3.3 Redline Changes to Final and Fabrication Approval Drawings

The design authority may temporarily modify EDCC-controlled fabrication drawings, using redlines to reflect special changes that must be acted on immediately. Use redlines only during fabrication and initiate only under critical schedule conditions. Redline changes are not submitted to the review and approval of the drawing approvers. Therefore, those using redlines must be aware that, once redline changes have been incorporated into a formal DCN or drawing revision and formal review is completed, the changes may be disapproved, resulting in scrap or rework and ultimately cost and/or schedule impact. Implement redline changes for hardware built through JSC manufacturing as follows (note that hardware built by other manufacturing facilities may require other redlining procedures):

3.3.3.1 Manually Created Redlines

The design engineer redlines the production control copy of the affected drawing. This shall be the stand-alone master copy of the change until a DCN is submitted or the drawing is revised.

- The design engineer gives each set of redlines a circled sequential number, starting with number one. A set of redlines is defined as all redline changes made at a single point in time.
- The design engineer places the circled numbers near each redline in the set.
- The design engineer also places the circled number at the bottom of the drawing, just to the left of the title block along with the design engineer's initials and the date (see example in Figure A-4).

- d. The manufacturing organization is responsible for updating all copies that manufacturing uses, including quality assurance.

3.3.3.2 Electronically Created Redlines

If manual redline changes are unclear, the design engineer may electronically create a new drawing revision and provide that unreleased drawing to the production controller as the redline for that part. To use electronically created redlines, use the following procedure:

- a. The design engineer electronically creates the next revision of the drawing, implementing all desired changes. Make Description of Change Table entries to document the changes in accordance with Section 3.3.1. Incorporate any manually created redlines that were previously issued and document them at this time.
- b. The design engineer manually or electronically writes the word “REDLINE” in approximately one-half-inch characters below the title block where the status line of the released drawing will eventually appear. The date and the designer’s initials go next to the word “REDLINE.” This will signify that the new drawing revision is a redline, but not yet released into the EDCC. Place this notation on all sheets of the affected drawing – regardless of whether changes actually occur on all sheets. Circle the word “REDLINE” in red ink on the hard copy provided to the production controller. The manufacturing organization is responsible for updating all copies that manufacturing and quality assurance use, circling the word “REDLINE” in red on all copies.
- c. If additional manually created redlines must be made after issue of the electronically created redline, enter them on the electronically created redline rather than on previously released versions of the drawing. Follow the steps listed above in 3.3.3.1 when adding the manually created redlines.
- d. Incorporate redlines into a formal DCN or drawing revision at the earliest possible opportunity and incorporate it before hardware acceptance. The DCN or revision that incorporates the redlines shall only contain outstanding redlines and shall not contain new changes unless the additional changes do not change the physical characteristics of the hardware. For instance, the next assembly may be changed. The production controller may require that an electronically created redline be done at any time during the redline process if it is determined that manually created redlines are unclear.

3.3.4 Drawing Cancellation Procedure

Cancel (or void) a drawing by submitting a DCN stating the reason for cancellation.

Do not cancel drawings unless the hardware was never fabricated or has been destroyed or otherwise invalidated. It is strongly recommended that drawings be left inactive until the appropriate retirement time, rather than cancelled.

In the event that an existing drawing must be cancelled rather than retired, the OPR is responsible for notifying the EDCC and any known users of the drawing.

3.4 SECURITY CLASSIFICATION

3.4.1 Procedures for Classified Drawings

Approve and control classified drawings outside of the EDRS. Direct questions or problems regarding the marking, handling, or safeguarding of classified hardware or drawings to JSC Security.

3.4.2 Markings for Classified Drawings

Show security classification and related information on classified hardware and its drawings, as set forth in the “Marking Documents” section of the latest revision of JHB 1600.3. As a minimum, mark both sides of each classified drawing at the top and bottom to indicate security classification.

In addition, stamp hard copies to be folded or rolled with the classification on each corner of the back and front of the copy so that the classification will be visible no matter how the copy is folded or rolled.

3.4.3 Safeguarding of Classified Drawings

Storage and protection, accountability and control, and document transmittal standards applicable to drawings are set forth in the “Safeguarding Classified Information” chapter of JHB 1600.3. The originating organization follows the instructions therein, as well as all organizations involved in the receipt, processing, or handling of classified drawings.

3.5 GOVERNMENT DRAWINGS FURNISHED TO A CONTRACTOR

This section addresses the requirements and safeguards followed when JSC, as part of a negotiated agreement, transfers engineering drawings or drawing sets to a contract design activity for management of the drawings outside the EDRS/EDCC. Refer to Section 1.4 for drawings managed inside EDRS/EDCC for which the contractor is responsible.

3.5.1 Drawing Transfer Authority

JSC engineering drawing transfer authority shall be accomplished only through a program change request (CR). As a minimum, the program CR shall specify:

- a. The contract office (including CAGE Code) within the contract design activity accepting responsibility for the transferred drawings.
- b. The NASA JSC-approved drawing system where subsequent drawing changes will be controlled. See Section 1.4.2.1 for drawing system approval.
- c. The offices responsible for all phases of the hardware lifecycle (e.g. hardware design certification approval, maintenance and operation responsibilities, etc)...
- d. The JSC OPR that will receive the drawing set at contract completion.
- e. A complete list of transferred drawings and assigned serial/lot numbers.

3.5.2 Transfer CR Approval

All drawing transfer CRs shall be approved by EA2 Configuration Management. EA2 CM review and approval shall:

- a. Ensure the program CR will specify that revised and new drawing title blocks identify the contract design activity using their CAGE Code.
- b. Determine if the contractor drawing tracking system requires CM audit. Refer to Section 1.4.2.1 contractor drawing tracking system requirements.

3.5.3 Transferred Drawing Release

The approved program CR shall authorize EDCC to release drawings to the contract design activity only after the EDCC database has been updated for each transferred drawing. The update shall include:

- a. The program CR number
- b. The contract office of primary responsibility and CAGE Code
- c. Identify the drawing control system
- d. The contact phone number for updates and copies
- e. The EDCC database drawing status changed to "XFD"

3.5.4 Drawing Transfer Contract Requirements

The cognizant JSC contracting officer and technical monitor shall ensure that the drawing transition contract Data Requirement Descriptions (DRDs) and Lists specify, as a minimum, the contents of the following:

- a. Transferred Drawing Change Criteria – The contract DRD shall specify the criteria and procedures for deviations or modifications to the government-furnished drawings.
- b. Drawing Security - The contract DRD shall specify security requirements of all engineering drawings transferred and generated under the contract.
- c. Drawing Return Procedure- The contract DRD shall specify the procedures for the receipt of transferred electronic drawing images and electronic CAD files transferred to, revised by, or created by the contractor. All files shall be returned in native format. A complete list of the drawings and serial/lot numbers assigned shall be included.

3.5.5 Return of Transferred Drawings to JSC

The contract design activity shall return the drawings per the process set forth in Section 3.5.4, bullet C and shall safeguard the drawings until they are officially returned at contract completion.

3.6 RETIREMENT OF JSC ENGINEERING DRAWINGS

3.6.1 Policy

Appropriately dispose of and retire engineering drawings in accordance with the following documents:

- Title 36 of the Code of Federal Regulations, Chapter XII, Part 1234, Electronic Records Management
- NPR 1441.1 NASA Records Retention Schedules

3.6.2 Procedures

Upon request, the EDCC shall provide listings to the originating organizations of drawings eligible for retirement. Upon approval by the appropriate authority (branch chief or higher level), the EDCC shall retire the selected drawings and any unincorporated DCNs issued against them.

3.6.3 Retrieval of Retired Drawings

Originating offices may retrieve retired drawings that have not been incorporated in the electronic system by providing authorization signature in the charge-out section of the originator (yellow) copy of JSC form 214 and presenting it to the EDCC with the following information:

- a. Drawing number
- b. Drawing title
- c. Requester's name, division, NASA badge number, and phone number
- d. Justification for retrieval of drawing(s)

3.6.4 Retirement Records

The EDCC keeps on file a copy of each authorized list of retired drawings. Information from these lists or from the Drawing List File database shall be provided upon request. The EDCC shall also retain a retired aperture card file of retired drawings and their DCNs, copies of which may be obtained upon request.

4 CAD FILE CONTROL

4.1 Definition and Objective

The JSC CAD file control objective is to provide the minimum requirements for the control and storage of CAD files for JSC drawings released through the EDCC. The term "CAD File," used in this section, refers the complete set of native files required to open and modify a drawing or DCN. This includes the electronic 2D drawing and its familiar CAD solids representation of a mechanical part or assembly of parts and various other elements of defining a design configuration such as a schematic from an

electrical design. The term “control” refers to the organized management of the drawing native CAD file set in order to ensure security, uniqueness and version synchronization with its released EDCC engineering drawing (Version Integrity).

4.2 CAD Configuration Control Software

CAD files for EDRS/EDCC released drawings shall be controlled and stored using JSC-controlled databases and CAD configuration control software.

Contact the DDMS Project Manager to determine the approved JSC-Controlled CAD configuration control software for each CAD software tool (e.g. Pro/E, OrCAD, etc.).

NOTE: “JSC-controlled” indicates the approved database and CAD configuration control software owned and maintained by JSC. The intent of this requirement is to ensure JSC has full control of the CAD files.

4.2.1 CAD Configuration Control Software Requirements

The CAD Configuration Control Software as a minimum shall be able to:

- Assign a traceable attribute for each iteration of a stored file
- Assign traceable attributes for each file iteration which may be synchronized with its EDCC drawing revision and drawing release level per Section 4.4.3.
- Retrieve the exact CAD file set used for each stored revision of a drawing (As stored)
- Prevent modification of CAD files used in a released EDCC drawing
- Maintain relationships between CAD files (i.e. which files are required to open an assembly or drawing)
- Establish and maintain date modified

4.3 CAD File Naming Conventions

JSC drawing CAD file naming conventions shall adhere to the following:

1. CAD File name shall be a maximum of 32 characters long.
2. Each CAD file name shall be unique within the database.
3. Drawing CAD file names shall equal the 3-digit drawing number prefix and 8-digit drawing number reserved in EDCC plus file extension.
4. Part/Assembly CAD file names shall equal the complete part number plus file extension when submitting to EDCC for release.
5. For CAD files generated with software that creates a single file that contains both part/assembly and drawing, the CAD file shall be named using either the rules for a drawing file or a part/assy file.

6. If the assembly uses a distorted version of a component part and the software does not support flexible models, the CAD file name for that distorted component (e.g. springs, o-rings, etc.) shall be the eight-digit drawing number followed by an underscore and a descriptor.
7. For imported and commercial parts, the CAD File name shall be the complete part number along with the original file extension.

Exceptions: Non-compliant file naming conventions may be used if approved by the DDMS Project manager.

4.3.1 Tabulated Part Naming Conventions

4.3.1.1 Family Table Naming Convention

If a family table is used to create the model of a commercial or standard tabulated part used on a drawing, the generic 3D CAD model shall be named with its basic specification or standard part number.

4.3.1.2 Family Table Instance Naming Convention

Instances of the generic part shall include the basic part number and dash number.

Exceptions: Purchased libraries may use company naming convention.

4.3.2 CAD File Naming Examples

The following are examples of proper CAD File names:

- SED39654321.drw JSC Drawing
- SEG39654321-301.asm JSC Assembly
- SDG39123456-001.prt JSC Detail Part
- 39654321_oring.prt Part modified at assembly (Distorted)
- NAS6303.prt Family Table Generic Part
- NAS6303-10.prt Family Table Instance
- 176E110.prt Commercial Part
- VO616502-003.mdl Imported part

4.4 CAD File Submission, Attribute Promotion, Archiving, and Distribution

4.4.1 CAD File Submission

4.4.1.1 EDCC Audits

Periodic checks shall be made by the EDCC and DDMS to ensure CAD files are submitted.

4.4.1.1.1 EDCC Responsibility to Hold Drawings

The EDCC shall hold drawing release of any drawing found to be lacking CAD files in the JSC-controlled CAD control databases until the CAD files are submitted.

4.4.2 CAD File Revision Attribute

CAD file revision attribute values indicate the revision of its EDCC drawing. CAD file revision attribute values **shall** equal the revision of the depicted EDCC drawing.

NOTE: This requirement is not invoked in this version of JPR 8500.4. The requirement is listed now to allow users to begin migrating towards using this convention.

4.4.3 CAD File Release Level Attribute

The five CAD file release level attribute values indicate the design level of the product depicted in the EDCC drawing.

CAD file release level values shall be equal to one of the following:

Conceptual: The lowest release level indicates the design configurations supporting an evaluation of possible product or a feasibility study.

Preliminary: This release level indicates any design phase the designer may choose prior to FAB or FINAL promotion.

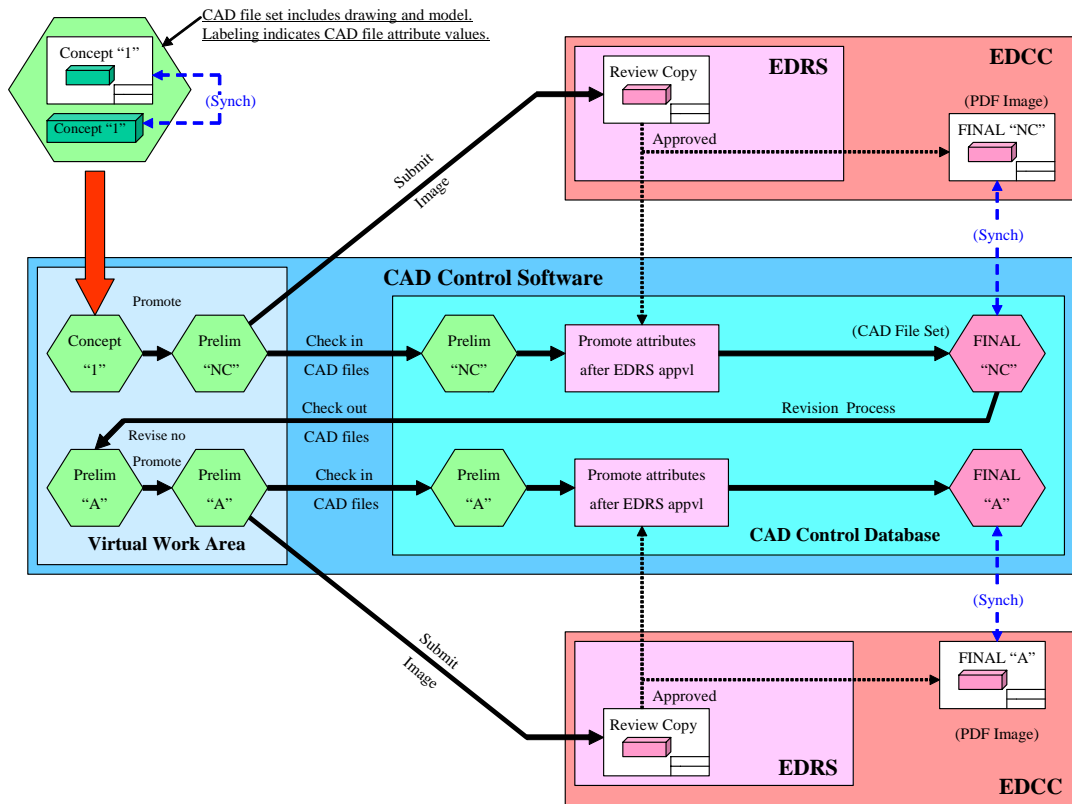
Fabrication (FAB): This release level indicates the design configuration has been approved for start of fabrication. CAD files at this release level cannot be modified.

Final: The highest release level indicating the design configuration has been approved for final inspection and acceptance of hardware. CAD files at this release level cannot be modified.

Retired: This release level indicates the archival storage of CAD files related to cancelled parts. CAD files at this release level cannot be modified.

Reference Only: This release level indicates a reference copy of a CAD file that is not configuration-managed in the JSC system. (e.g. COTS, standard parts, vendor parts, etc).

Figure 4.4-1. JSC CAD File Workflow



4.4.4 Model Distribution

Electronic model files shall be maintained in JSC DDMS CAD configuration control software and may be accessed through the system interfaces.

Appendix A

JSC STANDARD DRAWING

FORMATS

AND FORMS

Figure A-1. Drawing Format for Size A (Portrait)

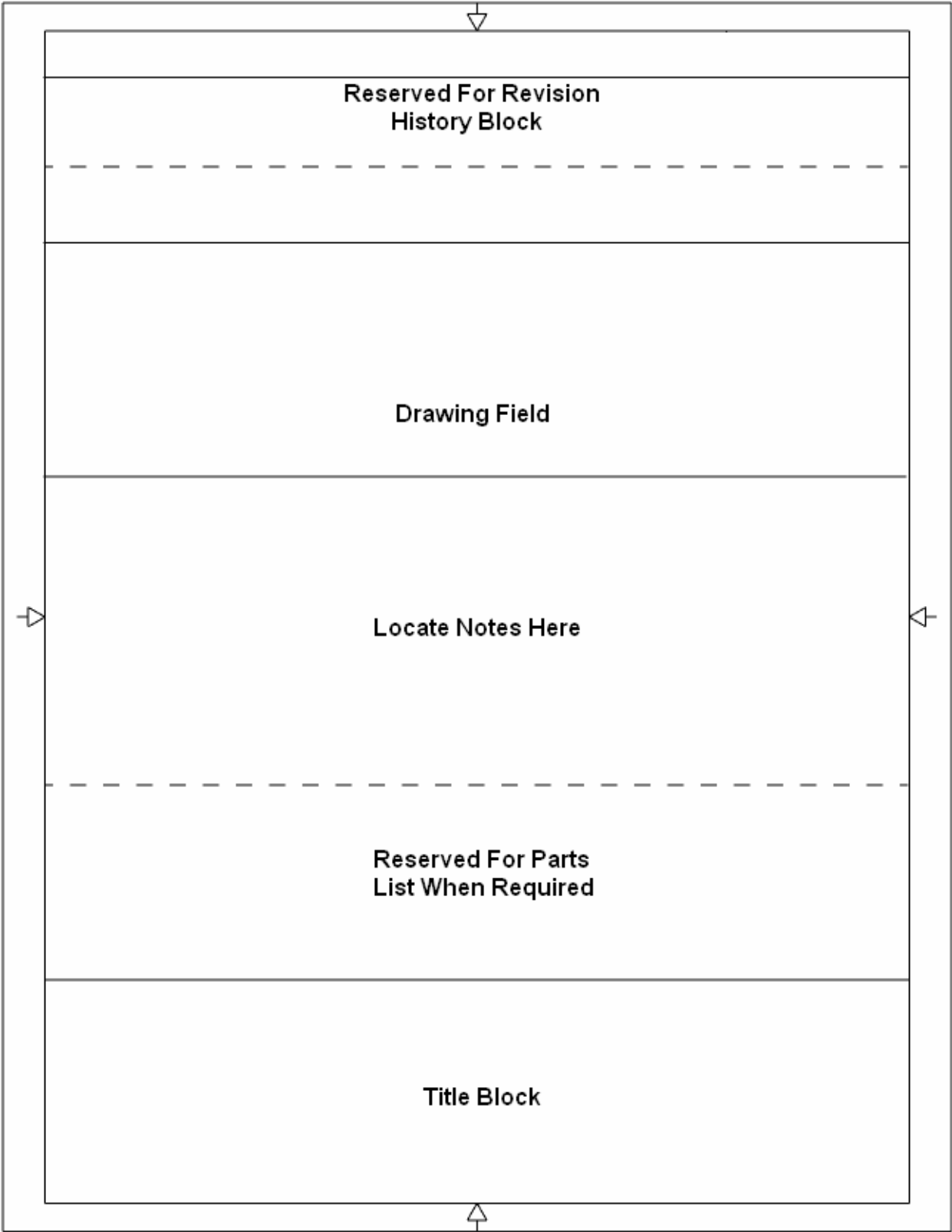


Figure A-2. Drawing Format for Size A (Landscape)

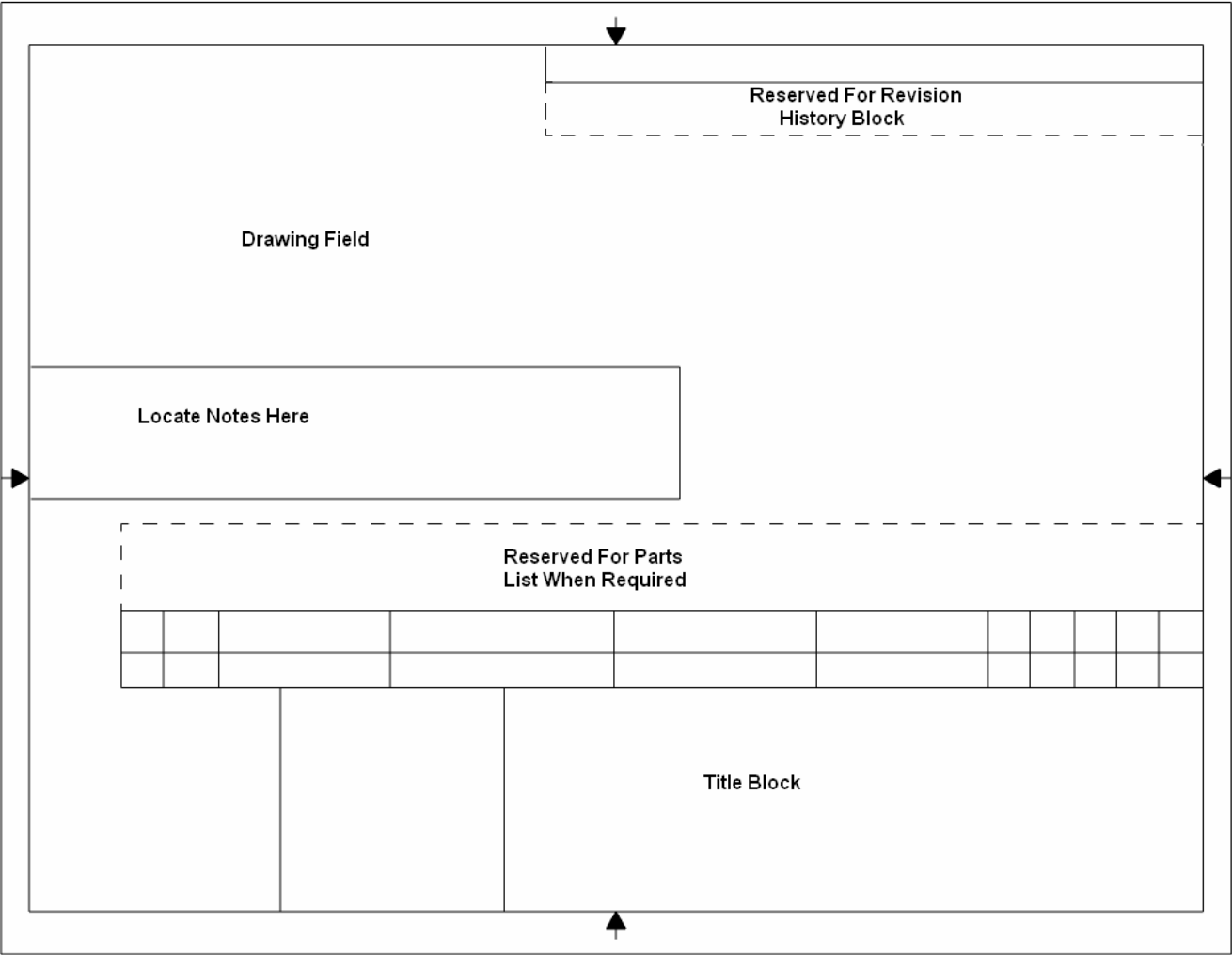


Figure A-3. Drawing Format for Size B and C

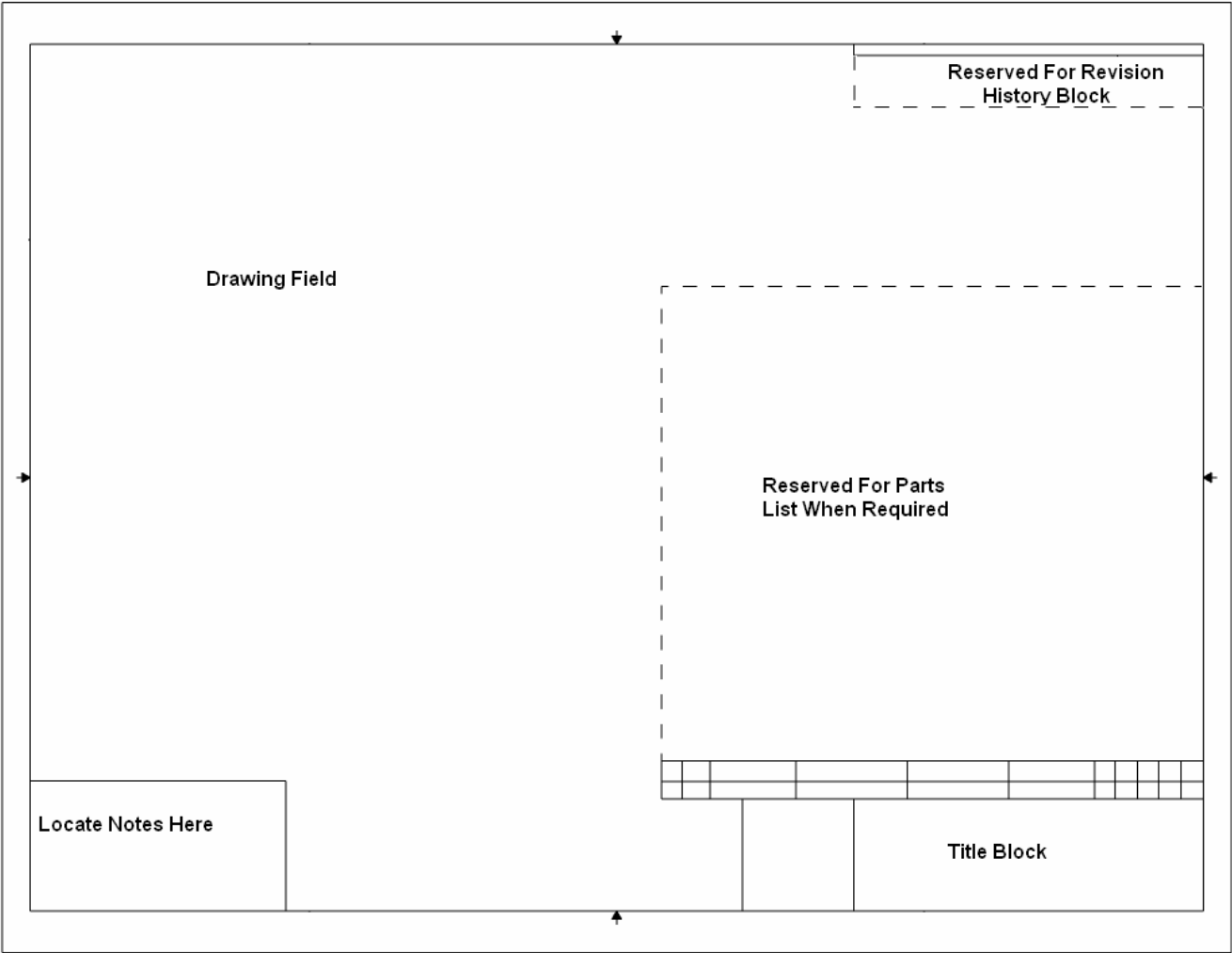


Figure A-4. Drawing Format for Size D, E, and F and Redline Example

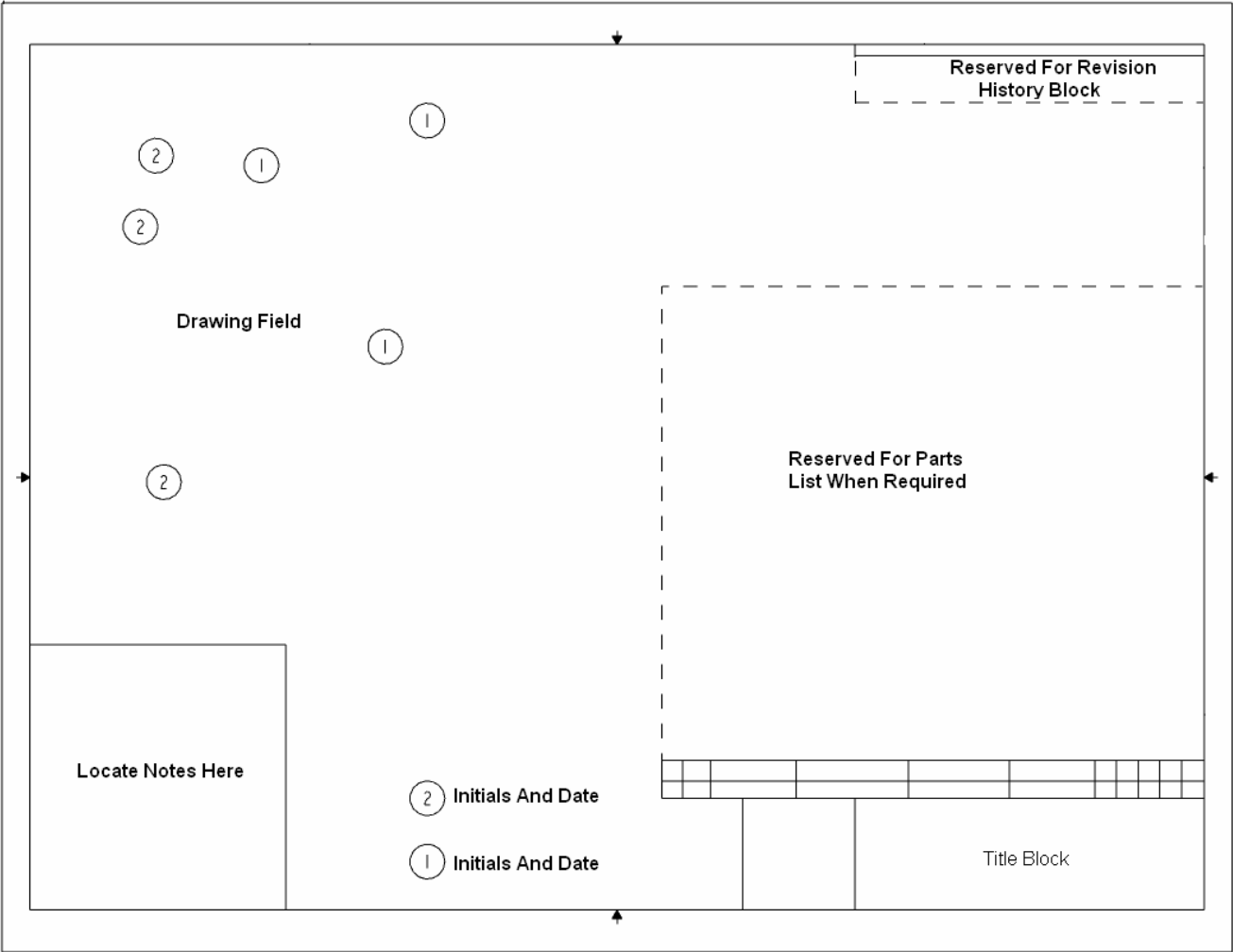


Figure A-5. DCN Form and Continuation Sheet

DCN Title Block (see Figure 12)	
Description of Change	

DCN NUMBER		DRAWING CHANGE NOTICE		SHEET OF
DWGNO	REV	SEQ #	FMT	

Appendix B

PARTS LIST ENTRY REQUIREMENTS

APPENDIX B PARTS LIST ENTRY REQUIREMENTS

Table B-1. Parts List Entry Requirements

Type of Part (12)	Quantity Required	CAGE Code (5)	Part Number	Description (10)	Material (1), (2)	Specification (4)	FRAC CRIT (6)	TRACE CODE (7)	REF DES (8)	FLAG NOTES (9)
JSC In House Part	Enter numeric quantity or "X", as appropriate (see examples).	21356	Enter part number including dash number; enter only the dash number for parts on parent drawings unless a separate parts list is used in which case, enter the part number including the dash number.	Determine and enter the name for each part	On a detailed drawing enter material identification as per notes (1) & (2) below	On a detailed drawing enter specification	(Y/N)	Enter Trace Code	Optional	Optional
Other NASA Center or NASA Contractor Part	Enter numeric quantity	Enter CAGE Code	Enter part number including dash number	Enter only the name of the part as it appears on the drawing where it is detailed. Modifiers are not entered unless necessary for clarity.	Optional	Optional	(Y/N)	Enter Trace Code	Optional	Optional
Government, Military, Or Standards Committee/Institution Design Controlled Parts	Enter numeric quantity or AR	Enter CAGE Code (14)	Enter all identifying letters and/or numbers to identify the part (12)	Enter the basic name of the part as it appears on the standard sheet	Enter any material information required to procure the part.	Enter any specification information required to procure the part.	(Y/N)	Enter Trace Code	Optional	Optional
Private Vendor Design Controlled Parts. (COTS Products, Contractor Designed Products).	Enter numeric quantity or AR	Enter CAGE Code	Enter all identifying letters and/or numbers to identify the part	Determine and enter a basic name for the part	Enter any material information required to procure the part.	Enter any specification information required to procure the part.	(Y/N)	Enter Trace Code	Optional	Optional

Type of Part	QTY	CAGE Code (5)	Part Number	Description (10)	Material (1), (2)	Specification (4)	FRAC CRIT (6)	TRACE CODE (7)	REF DES (8)	FLAG NOTES (9)
Foreign Organization	Enter numeric quantity or AR	Enter CAGE Code (13)								
Bulk Materials (11)	Enter AR or numeric quantity	Enter CAGE Code	Enter all identifying letters and/or numbers to identify the part (12)	Determine and enter a basic name for the material	Enter any material information required to procure the part.	Enter any specification information required to procure the part.	(Y/N)	Enter Trace Code	Optional	Optional
Reference Documents (3)	Enter REF	(3)	Enter document number including revision (12)	Enter the title of the document	Not Required	Not Required	Not Required	Not Required	Not Required	Optional

Notes: AR - as required REF - Reference

- 1) Specify materials by entering all identifying letters and/or numbers. Include trade names (if applicable) which are part of this identification. Enter envelope dimensions of the part below the material using exact length specified on drawing or rounded up to next nearest tenth. When appropriate, include stock size and form (i.e., AL ALY 6061-T6 ANG 2 × 2 × 12.1 LG).
- 2) Material size dimensions shall not include excess material allowances for machine setup, tolerance stack-up, or other material margin requirements.
- 3) If a pick list is required to complete the assembly, list the pick list document number as a reference document. Enter CAGE code of the OPR for the document.
- 4) Specifications are required for all metals specified for flight and applicable GSE hardware. Specification includes slash numbers and/or dash numbers as applicable.
- 5) Enter the Commercial and Government Entity (CAGE) Code for the design organization for the part not the manufacturing CAGE Code for the part.
 - a. CAGE Codes are a government assigned configuration managed code. Therefore, it is a much more reliable identifier than company names which change constantly. Per DFARS 204.7302, all entities that do business with the federal government are required to have CAGE codes.
 - b. The official CAGE Search website is available via the EDCC.
 - c. For DDMS, this field in combination with the part number ensures uniqueness for each product in the system. The part number alone cannot guarantee uniqueness because the system will house data from many different organizations. Since NASA does not require a common part numbering system for each organization from which it receives data, it is possible that multiple organizations will have identical part numbers for different products.

- d. When selecting the Design CAGE Code, enter the CAGE Code for the organization responsible for design of that product, not the manufacture of that product. Manufacturing CAGE Codes will be tracked against “As Built” records not on drawings.
- e. CAGE codes are tied to locations. Some organizations have multiple sites and therefore multiple CAGE codes. In these cases, enter the parent CAGE code listed on the official CAGE code website. If there is no parent CAGE code listed, contact the technical representative for the item and ask for the CAGE code of the site that assigns the part number.
- f. Dash numbers of the drawing shall have the same CAGE code as the drawing (e.g. If a -50X series is added to depict a commercial item without a part number, the CAGE code remains the same as the drawing CAGE code).
- g. Additional information such as recommended source contact information may be provided as a flag note.
- h. If the design company does not have a CAGE code, contact the company to explain the necessity of CAGE code to do business with the federal government. The official CAGE code website available via the EDCC has instructions in the Frequently Asked Questions (FAQ) section explaining the application process. The process generally takes three to five business days.. If the company absolutely refuses to apply for a CAGE code, the design organization may want to consider another source to avoid procurement problems. If there are no alternate sources or parts and the part is required for the design, the design organization has several options.
 - i. Use the manufacturer’s CAGE code. When using a CAGE code for a manufacturer, the design organization shall use the following flag note in the parts list: The responsible design organization for this part has no CAGE code. The listed CAGE code 12345 is the XYZ manufacturer’s CAGE code, the recommended source for this part.
 - ii. Use the distributor’s CAGE code. When using a CAGE code for a distributor, the design organization shall use the following flag note in the parts list: The responsible design organization for this part has no CAGE code. The listed CAGE code 12345 is the XYZ distributor’s CAGE code, the recommended source for this part.
 - iii. Contractors working on completion form contracts can use their own CAGE code for the part. This means the contractor is accepting responsibility for choosing to use a part from a company with no CAGE code. This option is NOT allowed for civil servants or contractors working level of effort contracts. When using the contractor’s CAGE code, the design organization shall use the following flag note in the parts list: The responsible design organization for this part has no CAGE code. The listed CAGE code 12345 for ABC contractor indicates ABC has taken responsibility for choosing to use this part on this drawing. The recommended source for this part is XYZ vendor.
 - iv. Assign a -50X series part number and use the same CAGE code as the drawing. Refer to 2.3.7.1.4. Note: caution should be used in selecting this method because it adds the overhead of re-identifying the vendor’s part. For low quantity production runs, this option may be viable.

- v. Use NONE for the CAGE code. The EDCC may hold drawings with parts NONE as the CAGE code to investigate if all options were pursued to obtain a CAGE code. When using NONE as the CAGE code, the design organization shall use the following flag note in the parts list: The responsible design organization for this part has no CAGE code. The recommended source for this part is XYZ vendor.
 - i. If the company that designed the part no longer exists, use one of the following options:
 - i. For companies that were bought, use the CAGE code for the parent company.
 - ii. If there is still a manufacturer for the part, use the manufacturer's CAGE code. When using a CAGE code for a manufacturer, the design organization shall use the following flag note in the parts list: The responsible design organization for this part no longer exists. The listed CAGE code 12345 is the XYZ manufacturer's CAGE code, the recommended source for this part.
 - iii. If stock can be purchased from distributors, use the CAGE code from the distributor that it is purchased. When using a CAGE code for a distributor, the design organization shall use the following flag note in the parts list: The responsible design organization for this part has gone out of business. The listed CAGE code 12345 is the XYZ distributor's CAGE code, the recommended source for this part.
 - iv. For companies, that went out of business and previously purchased stock is still available for use in production, use the old CAGE code. The old code should still be listed in the official CAGE Code website. When using a CAGE code for a defunct company, the design organization shall use the following flag note in the parts list: The responsible design organization for this part has gone out of business. The listed CAGE code 12345 is the XYZ vendor's former CAGE code. The only source for this part is previously purchased stock maintained by ABC Contractor (or NASA Center, XYZ).
 - v. If none of the other options apply and the non-existent company did not have a CAGE code, use the CAGE code of the design organization releasing the drawing. When using a CAGE code for a the design organization releasing the drawing, the design organization shall use the following flag note in the parts list The responsible design organization for this part has gone out of business. The listed CAGE code 12345 is the CAGE code of the design organization for this drawing. The only source for this part is previously purchased stock maintained by this organization.
- 6) Enter "Y" or "N" in this column. For detail parts, "Y" (yes) indicates the part is fracture critical and "N" (no) indicates it is not. For assemblies or installations, "Y" (yes) indicates the assembly or installation contains fracture critical components and "N" (no) indicates it does not.
 - 7) Enter trace code per Section 3.1.2.1.
 - 8) Enter reference designator numbers. Reference designators are used to locate multiple components of the same part number in different locations on the face of the drawing (commonly used on but not limited to electrical schematics).
 - 9) Enter numerical references of any required flag notes separated by a comma. DO NOT enter the flag symbol or text of the note.
 - 10) Enter part name using ASME Y14.100 naming conventions.

- 11) Bulk Items - Materials for which the quantity required cannot easily be determined such as solder, adhesives, paints, lubricants (e.g. ceramic coating, solid film lubricant, etc.), thread, cloth, electrical wire, etc. shall be entered on the parts list.

Material used in controlled processes shall not be entered on the parts list if the process is more important than control of the material. Consult with Structural Engineering Division Materials and Processes Branch to determine whether to enter the item on the parts list. The following are examples of materials that shall not be entered in the parts list

1. Materials used to produce permanent surface protection (e.g. electroplating, passivating, anodizing, chromate conversions)
2. Materials used as a thinning, reducing, or cleaning agent required in conjunction with the application of a protective coating

Bulk items that are required to be shown on the parts list shall be shown on the parts lists in their assembled relationship. Refer to Table B-7 for an example. This allows for the automation of indentured parts lists creation in DDMS.

- 12) See Section 2.1.3.8 for restrictions on part numbers, material and process callouts.

- 13) Enter the CAGE Code or NATO Commercial and Governmental Entity (NCAGE) Code. If the foreign organization does not have a CAGE or NCAGE Code, ask the organization to apply for a code. The official CAGE code website available via the EDCC has instructions in the Frequently Asked Questions (FAQ) section explaining the application process. If the organization refuses to apply for a CAGE code, use NONE for the CAGE code. When using a five-character acronym or abbreviation as the CAGE code, the design organization shall use the following flag note in the parts list: The responsible design organization for this part has no CAGE code. The listed CAGE code is an acronym (abbreviation) representing XYZ foreign organization, the source for this part.

- 14) Enter the CAGE Code of the government, military, or standards committee/institution responsible for maintaining the part design.

NOTES:

- a. The NATIONAL AEROSPACE STANDARDS COMMITTEE AEROSPACE INDUSTRIES (CAGE Code 80205) is responsible for all NAS and NASM specifications.
- b. If a military department is not the preparing activity, the preparing activity is often the Defense Logistics Agency (CAGE Code 14153).
- c. Many of the military standards and specifications have now been transferred to various standards committees such as Society for Automotive Engineers (SAE) (CAGE Code 81343).
- d. Military specifications or standards, that have not been transferred, shall use the Preparing Activity for that specification or standard. Common Preparing Activities are listed below..

Common government, military, and Standards Committee/Institution - CAGE Codes:

Entity	CAGE Code
AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) INC	05047
AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)	81346
DEFENSE LOGISTICS AGENCY (DLA)	14153
INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)	97566
NATIONAL AEROSPACE STANDARDS COMMITTEE, AEROSPACE INDUSTRIES ASSOCIATION (AIA)	80205
MILITARY SPECIFICATIONS PROMULGATED BY MILITARY DEPARTMENTS	81349
MILITARY STANDARDS PROMULGATED BY MILITARY DEPARTMENTS	96906
SOCIETY OF AUTOMOTIVE ENGINEERS (SAE) INC	81343

EXAMPLES:

Typical parts list entry for drawings depicting a single item (Monodetail)

Table B-2. Monodetail Integral Parts List Example

	21356	-001	BRACKET	6061-T651 AL ALLOY SH 4.1X2.6X.125 STK	AMS-QQ-A-250/11	N	TS			1, 2
QTY	CAGE CODE	PART NUMBER	DESCRIPTION	MATERIAL	SPECIFICATION	FRAC CRIT	TRACE CODE	REF DES	ITEM	FLAG NOTES

Typical parts list entry for assembly drawings where component details are shown on the same assembly drawing (Multidetail)

Table B-3. Multidetail Integral Parts List Example

AR	83574	515-700/910-704	PRIMER, EPOXY, SUPER KOROPON			N	TL		4	
2	80205	MS21209CO410L	INSERT, SCREW THREAD,			N	TL		3	4, 5
1	21356	-002	BEAM, LEFT SIDE	7075-T7351 AL ALLOY 29.6X5.1X2.0	AMS-QQ-A-250/12	N	TS		2	1
1	21356	-001	BEAM, RIGHT SIDE	7075-T7351 AL ALLOY 29.6X5.1X2.0	AMS-QQ-A-250/12	Y	TS		1	3
	21356	-301	BEAM ASSEMBLY			N	TS			
QTY	CAGE CODE	PART NUMBER	DESCRIPTION	MATERIAL	SPECIFICATION	FRAC CRIT	TRACE CODE	REF DES	ITEM	FLAG NOTES

Typical parts list entry for assembly drawings where component details are shown on separate drawings and with multiple assembly configurations

Table B-4. Assembly Integral Parts List Example


REF	REF	21356	SID39124601	WIRING SCHEMATIC							
AR	83574	515-700/910-704	PRIMER, EPOXY, SUPER KOROPON			N	TL		4	ALL SHTS	
2	80205	MS21209CO410 L	INSERT, SCREW THREAD, LOCKING			N	TL		3	SH2	4, 5
1	21356	-002	BEAM, LEFT SIDE	7075-T7351 AL ALLOY 29.6X5.1X2.0	SAE-AMS-QQ-A- 250/12	N	TS		2	2 C	4 1
1	21356	-001	BEAM, RIGHT SIDE	7075-T7351 AL ALLOY 29.6X5.1X2.0	SAE-AMS-QQ-A- 250/12	Y	TS		1	1 D	2 3
	21356	-301	BEAM ASSEMBLY			N	TS			1 A	7
QTY	CAGE CODE	PART NUMBER	DESCRIPTION	MATERIAL	SPECIFICATION	FRAC CRIT	TRACE CODE	REF DES	ITEM	ZONE	FLAG NOTES

Table B-5. Separate Parts List Example – Multi-Dash Number

PARTS LIST

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

REVISION: NC

SEK51300002

LYNDON B. JOHNSON SPACE CENTER

DCN: 01

GENERAL ASSY – FLIGHT VEHICLE

FINAL APP 3/22/04

ITEM	-302	-301	CAGE CODE	PART NUMBER	DESCRIPTION	MATERIAL	SPECIFICATION	FRAC CRIT	TRACE CODE	REF DES	ZONE	FLAG NOTES
		X	21356	SEK51300002-301	GENERAL ASSY - FLIGHT VEHICLE			Y	TS			
	X		21356	SEK51300002-302	GENERAL ASSY - FLIGHT VEHICLE			Y	TS			
1	1	1	21356	SEK51300002-001	SHIM	LAMINATED AL SHIM	MIL-S-22499/1	N	TS		SH5 E5	2
2		1	21356	SEK51300100-301	PRIMARY STRUCT ASSY			Y	TS		SH2 C5	
3	1		21356	SEK51300100-302	PRIMARY STRUCT ASSY			Y	TS		SH2 G5	
4	1	1	21356	SGK51340011-401	INSTALLATION, TRUNNION RETRACTION MECH			Y	TS		SH3 D4	
5	1	1	21356	SGK51346101-401	INSTALLATION, NOSE LANDING GEAR			Y	TS		SH4 D4	
6	1	1	21356	SGK51346102-401	FITTING INSTALLATION - NOSE LANDING GEAR			Y	TS		SH4 D4	
7	1	1	21356	SGK51346201-401	INSTALLATION, MAIN LANDING GEAR			Y	TS		SH4 C8	
8	1	1	21356	SGK51346201-402	INSTALLATION, MAIN LANDING GEAR			Y	TS		SH4 G8	
9	1	1	21356	SGK51346202-401	FITTING INSTALLATION - MAIN LANDING GEAR			Y	TS		SH4C 8	
10	1	1	21356	SGK51346202-402	FITTING INSTALLATION - MAIN LANDING GEAR			Y	TS		SH4 G8	
11	1		21356	SGK51371099-401	CARRIER PANEL INSTL AS-09			N	TS		SH5 C5	
12	24	16	80205	NAS1587-9C	WASHER, CSK			N	TL		SH4	
13	24	16	80205	NAS1805-9P	NUT, SELF-LOCKING			N	TL		SH4	
14	24	16	80205	NAS6709U74	BOLT, HEX HEAD			N	TL		SH4	
15	AR	AR	83574	515-700/910-704	PRIMER, EPOXY, SUPER KOROPON			N	TL		ALL	5

SHEET 1 OF 1

Table B-6. Separate Parts List Example - Single-Dash-Number

PARTS LIST
SEK51346112
BRACKET ASSY, PYRO NUT - NLG FIXTURE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER

REVISION: NC
DCN: 01
FINAL APP 3/22/04

ITEM	QTY	CAGE CODE	PART NUMBER	DESCRIPTION	MATERIAL	SPECIFICATION	FRAC CRIT	TRACE CODE	REF DES	ZONE	FLAG NOTES
	X	21356	SEK51346112-301	BRACKET ASSY, PYRO NUT - NLG FIXTURE			Y	TS			
1	1	21356	SEK51346106-301	BRACKET ASSY, PYRO NUT - NOSE LANDING GEAR			Y	TS			
2	1	21356	SEK51300126-001	MOUNTING BLOCK, PYRO I/F - NLG FIXTURE			N	TS			
3	8	80205	NAS1587-6C	WASHER, CSK			N	TL			
4	8	80205	NAS1805-6P	NUT, SELF-LOCKING,			N	TL			
5	8	80205	NAS6706U17	BOLT, HEX HEAD			N	TL			
6	AR	30676	AEROGLAZE 9743/9700	PRIMER, EPOXY			N	TL			

SHEET 1 OF 1

Table B-7. Separate Parts List Example – Tabulated Detail Part Drawing with Bulk Item

The parts list indicates the assembled relationship of the bulk items to the part instances, but the instances are still considered detail parts and retain detail part dash numbers.

PARTS LIST

SDD331227890

PIN

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

LYNDON B. JOHNSON SPACE CENTER

REVISION: NC

DCN: 01

FINAL APP 3/22/04

ITEM	-004	-003	-002	-001	CAGE CODE	PART NUMBER	DESCRIPTION	MATERIAL	SPECIFICATION	FRAC CRIT	TRACE CODE	REF DES	ZONE	FLAG NOTES
1				X	21356	SDD33127890-001	PIN, CRANK	15-5 PH STAINLESS STEEL Ø.4 X 1.0	AMS 5659	N	TS			
2			X		21356	SDD33127890-002	PIN, COUPLER	15-5 PH STAINLESS STEEL Ø.5 X 1.2	AMS 5659	N	TS			
3		X			21356	SDD33127890-003	PIN, ROCKER	15-5 PH STAINLESS STEEL Ø.7 X 3.3	AMS 5659	N	TS			
4	X				21356	SDD33127890-004	PIN, ROLLER	15-5 PH STAINLESS STEEL Ø.6 X 1.5	AMS 5659	Y	TS			
5		AR		AR	34568	TIOLUBE 460	LUBRICANT, DRY-FILM			N	TL			
6	AR				2R128	BRAYCOTE 602EF	MOS2 GREASE			N	TL			

SHEET 1 OF 1

Table B-8. Separate Parts List Example – Contractor's using Contractor CAGE Code per Section 1.4

PARTS LIST
SEG46119472
CANNISTER ASSY, CBS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER

REVISION: NC
DCN: 01
FINAL APP9/02/05

ITEM	-302	-301	CAGE CODE	PART NUMBER	DESCRIPTION	MATERIAL	SPECIFICATION	FRAC CRIT	TRACE CODE	REF DES	ZONE	FLAG NOTES
		X	348M3	SED33119999-301	CANISTER ASSY, LH			N	TS			
	X		348M3	SED33119999-302	CANISTER ASSY, RH			N	TS			
1		1	348M3	SDD33119998-001	SHIM	LAMINATED AL SHIM	MIL-S-22499/1	N	TL		SH2 E3	1
2	1		348M3	SDD33119998-002	SHIM	LAMINATED AL SHIM	MIL-S-22499/1	N	TL		SH2 E4	1

Sheet 1 of 1

Appendix C

DEFINITIONS OF HARDWARE DRAWING TYPES

Term	Definition
Flight/GSE Elect Software	<p>Description: Electrical, electronic and software drawings that define or help to define flight equipment or GSE (Ground Support Equipment) and that do not define either physical materials subject to flight approval or structural integrity of physical parts.</p> <p>Approval exemptions: This drawing type does not require stress or materials approval.</p> <p>Example: An electrical diagram of the circuit for the EMU Helmet Lights.</p>
Flight/GSE Firmware	<p>Description: Firmware drawings that define or help to define flight equipment or GSE (Ground Support Equipment) and that do not define either physical materials subject to flight approval or structural integrity of physical parts.</p> <p>Approval exemptions: This drawing type does not require stress or materials approval.</p> <p>Example: A book form drawing that defines the programming for an EEPROM chip. However, this category would not include the drawing of the physical mounting of the chip in its assembly.</p>

Term	Definition
Flight/GSE Schematics	<p data-bbox="646 228 1409 380">Description: Drawings using lines, symbols, or other graphical representations rather than standard views to define or help to define flight equipment or GSE (Ground Support Equipment) and that do not define either physical materials subject to flight approval or structural integrity of physical parts.</p> <p data-bbox="646 415 1430 472">Approval exemptions: This drawing type does not require stress or materials approval.</p> <p data-bbox="646 508 1419 564">Example: A fluid diagram that depicts the cooling loop for a Space Station module.</p>
Flight/GSE Decals	<p data-bbox="646 600 1419 657">Description: Drawings that define decals, labels or nameplates for flight equipment or GSE (Ground Support Equipment).</p> <p data-bbox="646 693 1382 749">Approval exemption: This drawing type does not require stress approval.</p> <p data-bbox="646 785 1370 842">Examples: Soft goods labels, hazardous logo decals, Space Station Inventory Management System (IMS) bar code labels.</p>
Flight Crew Clothing	<p data-bbox="646 877 1398 993">Description: Drawings that define articles of clothing for flight crews for intra-vehicular ("shirt sleeve environment") use. However, any components of a pressurized space suit or launch escape suit would not be considered clothing.</p> <p data-bbox="646 1029 1382 1085">Approval exemption: This drawing type does not require stress approval.</p> <p data-bbox="646 1121 1393 1178">Example: A specification control drawing for the procurement of exercise shorts.</p>
Flight Food and Containers	<p data-bbox="646 1213 1406 1270">Description: Drawings that define food items and their containers for use by flight crews.</p> <p data-bbox="646 1306 1382 1362">Approval exemption: This drawing type does not require stress approval.</p> <p data-bbox="646 1398 1094 1423">Example: Crew preference food items.</p>
Flight Medical Supplies	<p data-bbox="646 1459 1317 1516">Description: Drawings that define medical items and their containers for use by flight crews.</p> <p data-bbox="646 1551 1382 1608">Approval exemption: This drawing type does not require stress approval.</p> <p data-bbox="646 1644 1005 1669">Example: Shuttle trauma pack.</p>

Term	Definition
Flight Portable COTS Photo Equip	<p>Description: Drawings that define commercial off-the-shelf (COTS) portable photographic items, modifications of such items, and their containers for use by flight crews. This does not include photographic equipment that is structurally mounted. Nor does it include JSC-built equipment – such items would be classified under the “Flight Hardware” category and stress requirements would be determined accordingly.</p> <p>Approval exemption: This drawing type does not require stress approval.</p> <p>Example: Nikkor 85mm lens.</p>
Flight/GSE Electrical Cable	<p>Description: Drawings that define the makeup but not the installation of electrical, electronic or fiber optic cable or wiring subassemblies for flight or GSE use.</p> <p>Approval exemption: This drawing type does not require stress approval.</p> <p>Examples: Serial Data Interface Cable, fiber optic cables, etc.</p>
Flight ICD	<p>Description: Control drawings that define the agreed-upon interfaces between two or more flight articles developed by two or more different design entities.</p> <p>Approval exemptions: This drawing type does not require stress, materials, or quality approval.</p> <p>Special approval: Since these drawings formalize and document a multi-party agreement, the approval of an Authorizer is required to indicate that all parties have agreed to the information thereon before the drawing can be released.</p>
Flight CCCD/SSCCD	<p>Description: Drawings that define the location of flight items in the vehicle or Station crew compartments (flight deck, mid-deck, hab module etc.).</p> <p>Approval exemptions: This drawing type does not require stress, materials or quality approval nor does it require approval from an engineer.</p> <p>Example: CCCD for STS-104.</p>
Flight	<p>Description: Drawings of equipment for use in space flight that is not addressed specifically by other flight drawing types.</p>
Aircraft operations	<p>Description: Drawings of equipment for use in aircraft operations.</p> <p>Examples: 747 Shuttle Carrier Aircraft Configurations, reduced gravity aircraft, T-38's.</p>

Term	Definition
GSE	<p>Description: Drawings of Ground Support Equipment (GSE) - see JPD 8500.2 for the definition of GSE as it is used in this document.</p> <p>Example: Neck Plate Adapter for Short EMU.</p>
Crew Trainer	<p>Description: Drawings of flight-like equipment which has been modified or configured for training purposes. Such equipment may use non-flight fabrication and inspection processes, material changes, addition of fixtures for 1-G support, and deletion of functional components.</p> <p>Approval exemptions: This drawing type does not require approvals from stress, materials or quality.</p> <p>Example: Vehicle training mockups.</p> <p>Defer to splinter group with Stress, Materials, Quality, and EA2.</p>
Developmental	<p>Description: Drawings of developmental equipment used for the evaluation of conceptual configurations and not intended for flight use.</p> <p>Approval exemptions: This drawing type does not require approvals for stress, materials or quality.</p> <p>Example: Development unit of a Tile Repair Applicator Gun concept.</p>
Engineering Unit	<p>Description: Drawings of equipment identical to or very similar to flight equipment but which is to be used only for engineering evaluation and not for flight, qualification, or certification use.</p> <p>Approval exemptions: This drawing type does not require approvals from stress, materials or quality.</p> <p>Example: SAFER (Simplified Aid for EVA Rescue) Engineering Unit.</p>
Mockup NBL	<p>Description: Drawings of mockups for use in underwater (Neutral Buoyancy Lab) training or testing.</p> <p>Approval exemptions: This drawing type does not require approval from stress, materials or quality.</p> <p>Examples: Plastic PGT (Pistol Grip Tool) for NBL training exercises, high-fidelity mockup of Hubble Space Telescope Radial Instrument Bay.</p>

Term	Definition
Mockup-SVMF	<p>Description: Drawings of mockups or mockup equipment for training or testing in the Space Vehicle Mockup Facility.</p> <p>Approval exemptions: This drawing type does not require stress, materials or quality approval.</p> <p>Examples: High fidelity flight deck instrument panel for the Crew Compartment Trainer.</p>
Mockup-Other	<p>Description: Drawings of mockups or mockup equipment other than those used in the Neutral Buoyancy Lab or Space Vehicle Mockup Facility.</p> <p>Approval exemptions: This drawing type does not require approval from stress, materials or quality.</p> <p>Example: Portable Life Support System sublimator mass mockup.</p>
Non-flight Software	<p>Description: Software drawings that are not used for the definition of flight software.</p> <p>Approval exemptions: These drawings do not require stress, materials or quality approval.</p>
Non-flight Firmware	<p>Description: Firmware drawings that are not used for the definition of flight firmware.</p> <p>Approval exemptions: These drawings do not require stress, materials or quality approval.</p>
Non-flight Schematic	<p>Definition: Schematic drawings that are not used in the definition of flight equipment.</p> <p>Approval exemptions: These drawings do not require stress, materials or quality approval.</p>
Non-flight Other	<p>Description: Drawings that define non-flight equipment that is not addressed specifically by other non-flight drawing types.</p> <p>Approval exemptions: These drawings do not require stress, materials or quality approval.</p>
Prototype	<p>Description: Drawings of uncontrolled equipment identical to or very similar to flight equipment but which is to be used only for prototype evaluation and not for flight, qualification, or certification use.</p> <p>Approval exemptions: These drawings do not require stress, materials or quality approval.</p> <p>Example: Flight configuration satellite capture bar built with materials that are not flight approved and used for preliminary evaluation only.</p>

Term	Definition
Test Support Equipment	<p data-bbox="644 228 1411 380">Description: Drawings of uncontrolled equipment that is used in a supporting role in conjunction with test articles. If the equipment meets the definition of Ground Support Equipment (GSE) in JPD 8500.2, then the drawing type should be GSE, not Test Support Equipment.</p> <p data-bbox="644 384 1352 441">Approval exemptions: These drawings do not require stress, materials or quality approval.</p> <p data-bbox="644 474 1398 594">Example: Shaker table for vibro-acoustic testing of flight articles. However, an adapter that is used in attaching the flight article to the shaker table would be GSE rather than Test Support Equipment because of its direct interface with flight hardware.</p>
DCN to Change OPR	<p data-bbox="644 627 1419 779">Description: Drawing Change Notice that transfers drawing ownership from one OPR (Office of Primary Responsibility) to another. Such DCNs are necessary prior to drawing revisions that change the organization code in the title block due to EDRS automated process limitations (see section 3.3.2).</p> <p data-bbox="644 812 1323 869">Approval exemptions: These DCNs do not require stress, materials or quality approval.</p> <p data-bbox="644 873 1406 961">Special approval: This type DCN requires an Authorizer approval from the original OPR to indicate agreement with the transfer of ownership of the drawing.</p> <p data-bbox="644 995 1411 1081">Example: A DCN that changes the organization code of the Micro Wireless Instrumentation System (MWIS) Replaceable Recorder Assembly drawing from EV to EB.</p>